Engineering Library

JUL 24 1929

The Engineer.

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VOL. CXLVIII.—No. 3835] LONDON: FRIDAY EVENING, JULY 12, 1929 [PRICE ONE SHILLING BY INLAND POST 1s. 3d.

PUBLIC NOTICES

WIRING, &c.

The Commissioners of His Majesty's Works, &c., are prepared to receive TENDERS before 11 a.m. on Wednesday, 31st July, 1929, for ELECTRIC LIGHTING and POWER at the Natural History Museum, South Kensington, S.W.

Drawings, specification, a copy of the conditions and form of contract, bills of quantities and form of Tender may be obtained from the CONTRACTS BRANCH, H.M. Office of Works, King Charles-street, London, S.W. 1, on payment of One Guinea. (Cheques payable to the Commissioners, H.M. Office of Works.) The sums so paid will be returned to those persons who send in Tenders in conformity with the conditions. 2532

The Director-General, India Store Department, Belvedere-road, Lambeth, London S.E. 1, invites TENDERS for :—

421 CAST IRON LATRINE PANS.

Tenders due 23rd July, 1929.

Forms of Tender available from the above at a fee of 5s. (which will not be returned). 2543

Crown Agents for the COLONIES,

COLONIAL GOVERNMENT APPOINTMENTS.

APPLICATIONS from qualified candidates are INVITED for the following POSTS :—

M/1579.—ENGINEER (ARCHITECTURAL) REQUIRED by the GOVERNMENT of HONG KONG for the Public Works Department for three years' service and possible permanency. Salary £460 a year, rising by annual increments of £20 to £500 a year, and thereafter, in the event of the appointment being made permanent, by further increments to a maximum of £1000 a year, payable in dollars under the Compensation Scheme at present in force at a favourable rate of exchange. Free first-class passages provided. Candidates, unmarried, 23 to 30 years of age, must be Associates of the R.I.B.A. and be conversant with all the usual routine of an architectural office, including the preparation of sketch plans and working drawings, specifications, quantities, measuring, &c., in connection with new buildings, additions and alterations. Some knowledge of steel and reinforced concrete design and construction is also necessary.

M/1615.—ASSISTANT ENGINEER REQUIRED by the GOVERNMENT of NIGERIA for a tour of 12 to 18 months' service, with possible extension for the Construction of a Carter Bridge. Salary £510, rising to £720 by annual increments of £30. Free quarters, passages and liberal leave on full salary. Outfit allowance of £60 on first appointment. Candidates, 25 to 30 years of age, should have had previous experience of bridge construction and preferably should have passed Sections A and B of the examination for the A.M.I.C.E. Diploma or hold professional qualifications recognised by the Institution of Civil Engineers as exempting from those examinations.

Apply at once by letter, stating age, whether married or single, and full particulars of qualifications and experience, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, London, S.W. 1, quoting the reference number against the appointment for which application is made. 2535

The Government of MADRAS invite APPLICATIONS for an APPOINTMENT as ASSISTANT ENGINEER for the Pipe Line at Cochin Harbour, South India. Candidates must possess First Class Board of Trade Certificate. Experience in the manufacture of Ball Joints for Pipe Line desirable. Four years' agreement in first instance. Passages out and home for officer and family. Pay Rs. 500 a month, rising annually by Rs. 30 to Rs. 640 a month. Free accommodation for single officer; house rent allowance of Rs. 50 a month for married officer if family reside in India with him. Travelling allowances. Strict medical examination.

Forms of application and further particulars may be obtained (upon request by postcard) from the SECRETARY TO THE HIGH COMMISSIONER FOR INDIA, General Department, 42, Grosvenor-gardens, London, S.W. 1. Last date for receipt of applications 30th July, 1929. 2530

University College of Swansea.
(A Constituent College of the University of Wales.)
APPLIED SCIENCE DEPARTMENTS.

ENGINEERING.

Professor : FREDERIC BACON, M.A. (Cantab.), A.M. Inst. C.E., M.I. Mech. E., M.I.E.E.
Lecturer in Electrical Engineering : E. G. ISAACS, M.Sc. (Bristol), B.Sc. (Lond.), A.M.I.E.E.
Lecturer in Civil Engineering : A. A. FORDHAM, B.Sc. (Lond.), A.M. Inst. C.E., M.I. Struct. E.
Assistant Lecturer : J. SELWYN CASWELL, A.M.I. Mech. E.

METALLURGY.

Professor : C. A. EDWARDS, D.Sc. (Manchester).
Assistant Professor : L. TAVERNER, A.R.S.M.
Lecturer : L. B. PFEIL, D.Sc. (Lond.), A.R.S.M.
Assistant Lecturers : J. C. JONES, M.Sc. (Wales). R. GRIFFITHS, B.Sc. (Wales).

The College offers a number of exceptional advantages to Students who aim at entering upon professional careers in Engineering or in Metallurgy. It is situated in the heart of an industrial area which includes a large number of works of very varied character, and presents an unrivalled variety of metallurgical practice. The manufacturers of the district, who contribute largely to the support of the College, give the Staff and Students of the Applied Science Departments every access to the works, and the Managers, Engineers, and Technical Officials cooperate with the Staff of the College in making visits to Works of practical educational value to the Students.

Courses of study are provided (1) for the B.Sc. Degree of the University of Wales in (A) Civil Engineering ; (B) Mechanical Engineering ; (C) Electrical Engineering ; (D) Metallurgy ; and (2) for Diplomas of the College in (A) Civil Engineering ; (B) Mechanical Engineering ; (C) Electrical Engineering ; (D) Metallurgy.

Persons who are not desirous of studying for Degrees or Diplomas may attend selected College Classes, provided they satisfy the authorities of the College that they are qualified to benefit by such classes.

Entrance Scholarships will be offered for competition in September, 1929.

Particulars concerning admission to the College and of the Entrance Scholarships may be obtained from the undersigned.

EDWIN DREW,
Registrar.

Singleton Park, Swansea. 2480

The Engineer

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Leicester College of Technology.
Principal : L. W. KERSHAW, B.Sc., A.M. Inst. C.E., F.G.S.

APPOINTMENT OF HEAD OF ENGINEERING DEPARTMENT.

APPLICATIONS are INVITED for the POST of HEAD of the ENGINEERING DEPARTMENT, rendered vacant by the appointment of Mr. T. H. Jones, M.Sc., M.I. Mech. E., A.M. Inst. C.E., to the Principalship of York Technical Institute.

Candidates should possess an Honours Degree in Engineering and should have had works, teaching, and organising experience.

Salary £600.

Particulars of duties may be obtained from the Registrar of the College, to whom completed applications should be submitted not later than July 22nd, 1929.

F. P. ARMITAGE,
2475 Director of Education.

Robert Gordon's Colleges, ABERDEEN.

The Governors invite APPLICATIONS for the POST of HEAD of the MECHANICAL ENGINEERING DEPARTMENT.

Candidates must be University Graduates in Engineering and have had thorough practical training in Mechanical Engineering and experience of instruction. Salary scale £500-£600 per session.

The Engineering Department of the College cooperates with the University of Aberdeen in providing Degree Courses in Engineering.

A statement of the duties attaching to the appointment may be had from the undersigned, with whom 17 copies of letter of application and of testimonials should be lodged not later than 29th July, 1929.

JAMES McKENZIE,
2411 Secretary and Registrar.

University of Leeds.

DEPARTMENT OF ENGINEERING.

The Council will shortly proceed to the APPOINTMENT of a DEMONSTRATOR in CIVIL and MECHANICAL ENGINEERING, to commence duties on the 1st October next; salary £300 a year.—Further particulars may be obtained from the REGISTRAR, The University, Leeds, who will receive applications for the appointment up to the 5th August, 1929. 2524

PUBLIC NOTICES

The Royal Technical College, GLASGOW.

DEPARTMENTS OF ENGINEERING.

MECHANICS AND MECHANICAL ENGINEERING : Professor Alexander L. Mellanby, D.Sc., M.I. Mech. E.
Associate Professor William Kerr, Ph.D., A.R.T.C., M.I. Mech. E.
ELECTRICAL ENGINEERING : Professor Stanley Parker Smith, D.Sc., M.I.E.E., A.M. Inst. C.E.
CIVIL ENGINEERING : Professor George Moncur, B.Sc., M. Inst. C.E., M. Amer. Soc. C.E.
MINING ENGINEERING : Professor Daniel Burns, M. Inst. M.E.
CHEMICAL ENGINEERING : Professor of Technical Chemistry : Thomas Gray, D.Sc., LL.D., Ph.D., F.I.C.

Complete courses of instruction are provided, qualifying for the Diploma and Associateship of the College and for the Degree of B.Sc. in Engineering of Glasgow University.

Composition fee, 25 guineas per annum.

SESSION 1929-30 BEGINS on TUESDAY, SEPTEMBER 24th.

Calendar, by post, 3s., and prospectus, gratis, may be obtained on application to the SECRETARY. 2491

The Rural District Council OF WALLINGFORD, BERKS.
DIDCOT WATER SUPPLY.
TO IRONFOUNDERS.

TENDERS are INVITED for the SUPPLY and DELIVERY of about 153 TONS of 7in. and 136 TONS of 6in. SPIGOT and SOCKET CAST IRON PIPES, with about 5 TONS of BENDS and BRANCHES for same.

Specification and bill of quantities may be obtained at the offices of the Engineers, Messrs. Fiddian and Deeley, 13, Church-street, Stourbridge, on and after the 15th inst., on payment of Two Guineas, which will be returned on receipt of a bona fide Tender with specification and bill of quantities duly priced in.

Two approved sureties will be required for the due performance of the contract.

The Council does not bind itself to accept the lowest or any Tender.

Sealed Tenders, endorsed "Tender for Cast Iron Pipes," to be sent to the undersigned not later than Noon on Thursday, the 1st day of August next.

P. C. A. SLADE,
Clerk to the Council.

7, St. Martin's-street, Wallingford, Berks.
July 6th, 1929. 2509

PUBLIC NOTICES

The Rural District Council OF WALLINGFORD.
DIDCOT WATER SUPPLY.
TO OIL ENGINE AND PUMP MANUFACTURERS.

The above Council invite TENDERS for the SUPPLY and ERECTION at West Hagbourne, near Didcot, of TWO OIL ENGINES driving through gearing TWO TURBINE BORE-HOLE PUMPS of a capacity of 8000 gallons per hour under a net head of 214ft.

Forms of Tender, general conditions, specification and drawings may be obtained from the Engineers, Messrs. Fiddian and Deeley, 13, Church-street, Stourbridge, on and after Monday, the 15th inst., on payment of a deposit of Two Guineas, to be returned upon receipt of a bona fide Tender, together with all incidental papers supplied therewith.

Sealed Tenders, endorsed "Tender for Oil Engine and Pumps," to be sent to the undersigned not later than Noon on Thursday, the 1st day of August next.

The Council do not bind themselves to accept the lowest or any Tender.

F. C. A. SLADE,
Clerk to the Council.

7, St. Martin's-street, Wallingford, Berks.
July 6th, 1929. 2510

South Indian Railway Company, LIMITED.

The Directors are prepared to receive TENDERS for the SUPPLY of :—

1. SOLID-DRAWN STEEL BOILER TUBES.
2. GALVANISED SHEETS.
3. SCREWS AND NAILS.
4. INDIA RUBBER PADS.
5. PLATE GLASS AND MIRRORS.

Specifications and forms of Tender will be available at the Company's Offices, 91, Petty France, Westminster, S.W. 1.

Tenders, addressed to the Chairman and Directors of the South Indian Railway Company, Limited, marked "Tender for Solid-drawn Steel Boiler Tubes," or as the case may be, with the name of the firm tendering, must be left with the undersigned not later than Twelve Noon on Friday, the 26th July, 1929.

The Directors do not bind themselves to accept the lowest or any Tender.

A charge, which will not be returned, will be made of 10s. for each copy of Specifications Nos. 1 and 2, of 5s. for each copy of Specifications Nos. 3 and 4, and of 2s. 6d. for each copy of Specification No. 5.

Copies of the drawings may be obtained at the offices of the Company's Consulting Engineers, Messrs. Robert White and Partners, 3, Victoria-street, Westminster, S.W. 1.

A. MUIRHEAD,
Managing Director.

91, Petty France, Westminster, S.W. 1.
10th July, 1929. 2555

The Directors of Petters (Ipswich), Limited, are prepared to receive TENDERS for the REMAINDEE of the STOCK-IN-TRADE of that Company, including engines partly manufactured and in progress, together with the stock of spare parts held against future orders, for replacement purposes, for engines supplied since 1919, together with the records, drawings, patterns, jigs, gauges and special tools and goodwill of such replacement business and the right, with certain obligations, to manufacture and sell spare parts made in accordance therewith.

Tenders, which must be accompanied by a cheque for 25 per cent. of the amount of Tender, must be sent in not later than Friday, the 26th July, addressed to

THE SECRETARY,
Petters (Ipswich), Limited,
Ipswich,

marked on the envelope
"Tender for Stock-in-Trade and Spare Part Business."

The Directors do not bind themselves to accept the highest or any Tender.

Further information can be obtained from the SECRETARY as above. 2497

NORTHERN INDIA
ENGINEERING DEVELOPMENT.

Many huge projects are completed, others are under construction, and still more are under consideration. When tendering, remember that we have handled, inter alia, all the material for the Lloyd Barrage, the largest irrigation scheme in the world, and that WE HAVE THE EXPERIENCE to enable us to quote you the most favourable terms for CLEARING and DESPATCHING up country any quantity of material to any site required.

For full particulars apply, EASTERN EXPRESS CO., Ltd., Karachi ; or to Messrs. FORBES, FORBES, CAMPBELL and CO., Ltd. (Managing Agents), 9, King William-street, London, E.C. 4. F 5209

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PUBLIC NOTICES

Greenwich Union.

FOR SALE.

The Guardians have TWO SETS of NEW FIRE-BARS, practically complete, suitable for Lancashire boilers, with 5ft. 6in. furnaces, FOR DISPOSAL at the Institution, Woolwich-road, Greenwich, S.E. 10. The above can be seen on application to the Master of the Institution.

Quotations should be sent to the undersigned.

By Order,
W. C. CORNISH,
Clerk to the Guardians.

Board Room, E. Greenwich, S.E. 10.
July, 1929. 2542

Clyde Navigation Trust.

DREDGING SUPERINTENDENT.

APPLICATIONS are INVITED for the VACANT POSITION of DREDGING SUPERINTENDENT, the duties attached to which include the supervision and working of the whole Dredging Plant engaged in the maintenance of docks and river. The person appointed must have had considerable experience in actual dredging operations, with a sound mechanical engineering training, able to deal with all matters affecting the maintenance and running of an extensive dredging plant. It is desirable that he should hold a First Class Marine Engineer's Board of Trade Certificate. He must be thoroughly capable of handling a large staff of men.

Replies, stating age, salary expected, and qualifications, to be addressed to the undersigned.

A. C. GARDNER, M. Inst. C.E., M.I. Mech. E.,
Engineer,
Clyde Navigation Trust.

16, Robertson-street, Glasgow, C. 2.
8th July, 1929. 2514

The Commissioners for the

PORT OF CALCUTTA.

APPLICATIONS are INVITED for the POST of an ELECTRICAL ENGINEER on Rs. 800/50/1200, and should be submitted to the undersigned not later than Monday, the 22nd July, 1929.

Applications will be considered from qualified Electrical Engineers who have had a sound general and technical education and who have served a full apprenticeship with a recognised firm, followed by at least five years' experience in the manufacture, erection and general maintenance of Electrical Machinery. Indian experience an asset.

Applicants are also required to be conversant with modern practice in H.T. and L.T. transformers and switchgear and the testing thereof, and in the application of electricity to modern machinery and ships.

Age not to exceed 38 years.

J. ANGUS, M. Inst. C.E.
10, Princes-street, Westminster, S.W. 1. 2499

SITUATIONS OPEN

COPIES OF TESTIMONIALS, NOT ORIGINALS, UNLESS SPECIFICALLY REQUESTED.

WANTED, a Capable and Energetic Young MAN to Take Charge of Electrical Department in Manchester district. Must have experience of quick production of A.C. and D.C. machines. Good salary to the right man.—Address, stating age and experience, 2549, The Engineer Office. 2549 A

WANTED by City Firm, a First-class SALESMAN of Pig Iron and Ferro-Alloys. Preference given to gentleman having knowledge of Non-ferrous Metal Trade.—Please address fully, P6003, The Engineer Office, stating experience, age, and salary required. P6003 A

WANTED for North China, ENGINEER, with comprehensive experience for a senior position, age about 35, good education and technical knowledge, wide experience of mechanical and construction work, administrative ability, and first-class personal qualities essential. Good prospects for a suitable man. —Apply, with full particulars and stating salary expected, to Box R.P.C., c/o Davies and Co., 95, Bishopsgate, London, E.C. 2. 2534 A

WANTED, PLANNER and RATE FIXER fo General Engineering Works in Midlands, with knowledge of Modern Machining and Erection Methods and Prices. State age, experience, salary, &c.—Address, 2547, The Engineer Office. 2547 A

WANTED, Young ENGINEER, Well Educated, as WORKS MANAGER of Small Factory engaged in precision work. Full knowledge of Automatic Machinery and Small Gear Cutters essential. Strict disciplinarian and able to organise quantity production. Preference given to man skilled in production of parts for meters or clockwork.—Address in confidence, stating age, experience, and salary required, P6000, The Engineer Office. P6000 A

ASSISTANT ENGINEER REQUIRED to Works Engineer in large Woodworking Factory, London district. Must have had good primary and technical education and at least two years' subsequent practical experience. Some knowledge of Boiler Management, Steam Engines, D.C. and A.C. Electrical Plant essential. Knowledge of building construction and maintenance would be considered an added qualification.—Apply, with full particulars of age, education, experience, and salary required, to A.E., c/o Harris Lebus, Finsbury Works, Tottenham, N. 17. 2553 A

CIVIL ENGINEER.—First-rate CIVIL ENGINEER REQUIRED AT ONCE for senior position in London office of Consulting Engineers.

Must be fully qualified technically and have had sound and varied works experience. Age 45-55.

Salary according to qualifications, but not less than £1000 per annum.

Write, stating age, giving concise particulars of training and experience and forwarding copies of not more than three testimonials.—Address, P5981, The Engineer Office. P5981 A

COMPETENT and Experienced ASSISTANTS REQUIRED temporarily in London for design of Mass and Reinforced Concrete and Steel Work. Salary £5 to £7 per week, according to ability.—Address, with full particulars, 2503, The Engineer Office. 2503 A

CONSTRUCTIONAL ENGINEERS in London REQUIRE SERVICES of STEEL WORK DESIGNER with similar experience. Give full particulars, age, experience, &c. Permanency.—Address, 2545, The Engineer Office. 2545 A

ELECTRICAL and MECHANICAL ENGINEER; knowledge and experience of Indian conditions and language preferred.

The duties are to hold charge of an electrical department in an Indian State of the Punjab, using E.H.T. in conjunction with modern steam plant, pumping mains, wiring, and general management of staff and office.

Bachelor preferred, age about 35/40.

Salary Rs. 600 per mensem with free quarters.

Second-class passages, 3 years' agreement.

Address applications, with full particulars and copies of testimonials, 2548, The Engineer Office, replies to which cannot be expected for about one month after submission of application. 2548 A

ENGINEER SALESMAN REQUIRED to be attached to London office of leading Manufacturer of Internal Combustion Oil Engines.—Address in confidence, stating age, training, experience, salary required, and when free, 2521, The Engineer Office. 2521 A

ENGINEER, Young, WANTED, with Drawing-office experience, accustomed to Main Steam Pipe Installations. Must be capable of measuring up and preparing drawings.—Address, 2550, The Engineer Office. 2550 A

SITUATIONS OPEN (continued)

ESTIMATOR WANTED; Capable Junior for Weight Calculations, &c., in general engineering estimate department. Must be quick and accurate.—Apply, with full particulars of experience, age, and wage required, to ROSE, DOWNS and THOMPSON, Ltd., Hull. 2504 A

GREAT CHEM. TECHN. CONCERN WANTS Some MECHANICAL ENGINEERS for the works, project office and technical purchase.

University training and some years' practice in the same line necessary.

Address applications, enclosing curriculum vitae, training, photo, copy of testimonials, references, and salary wanted, P5989, The Engineer Office. P5989 A

REQUIRED, Capable DESIGNER, to Take Charge of Commercial Vehicle Drawing-office. Must possess up-to-date experience of Double-deckers, Saloons and All-weather Coaches and be capable of turning out work quickly. Preference given to one having had similar position.—State age, experience, and salary required to Box 117, Advertising Offices, 84, Queen Victoria-street, London, E.C. 4. 2502 A

REQUIRED by an Important PUBLIC UTILITY COMPANY, a young qualified ENGINEER with mechanical experience and some knowledge of Hydro-electric Construction. State qualifications, experience, and salary required.

Address, P5980, The Engineer Office. P5980 A

REQUIRED for Important British-owned Railway in Argentina:—

CIVIL ENGINEERS for RAILWAY LOCATION, age up to 30.

Must be competent surveyors, Associate Members of the Institution of Civil Engineers, and capable of acting as Chiefs of Railway Location Parties. Salary: first year, £473 (to be raised to £524 on qualifying in the Spanish language); second and third years, £576 per annum, subject to satisfactory service.

Salary payable from date of sailing from England and free passage.

Reply, stating age, if single or married, and giving full particulars of education, training and experience, together with copies (only) of testimonials, to Box R.L.G., c/o Davies and Co., 95, Bishopsgate, London, E.C. 2. 2533 A

REQUIRED, First-class ASSISTANT for Large Structural General Engineering and Ship Repairing Works out East. Applicants must have served full apprenticeship in engineering workshops, with subsequent technical training at Engineering College or University and have obtained B.Sc. or B.E. Degree. Good appearance and address essential; public school man preferred. Single, age 25 to 28. Must be well up in Structural Work, able to estimate and check all calculations.—Write in first instance, stating salary expected, to Z.Z. 710, c/o Deacon's Advertising Agency, Fenchurch-avenue, London. 2541 A

REQUIRED IMMEDIATELY by Specialist Reinforced Concrete Engineers in Salisbury, Rhodesia, JUNIOR ENGINEER. Must be single. Neat and quick draughtsman and must have had experience in Reinforced Concrete Specialist Office. Salary about £25/£30 per month, with annual increase. Passage paid, 3 years' agreement.—Write, giving full details experience and reference, to Box 93, Frost-Smith Advg. Service, 64, Finsbury-pavement, E.C. 2. 2551 A

REQUIRED to Teach Engineering Subjects at Oundle School, an HONOURS GRADUATE (ENGINEERING). It is desirable, but not essential, that candidates should have had drawing-office and works experience.

Would intending candidates write as soon as possible to the HEADMASTER, Oundle School? P5970 A

SECTIONAL SUB-AGENT.—Sir JOHN JACKSON, Limited, REQUIRE the SERVICES of a MAN with full experience of the latest Electric and Steam Excavating Machines and who would be capable of controlling and arranging the traffic service between machines and dumps to the best advantage. Only men with such experience need apply, giving references, age, and salary required. Required for the Singapore Naval Base Contract.—Please apply to Sir JOHN JACKSON, Ltd., 53, Victoria-street, London, marking envelope "Sectional Sub-Agent." 2520 A

SEVERAL MARINE ENGINEERS REQUIRED, Canada, Australia, preferably with Petter Engine experience.—Apply by letter, PETTERS, Limited, 75B, Queen Victoria-street, London. P5994 A

TEMPLET MAKER for Structural Department in General Engineering Works. Must be a thoroughly experienced plater, able to accurately set out work full size on floor from drawings, including developed and built-up circular or flak specialties in addition to ordinary constructional work.—Apply, stating age, where experience has been gained, and salary. Constancy to first-class man; none other need apply.—G. P. BANBURY, East Surrey Ironworks, Croydon. P6002 A

YOUNG ENGINEER, with Surveying and Sanitary Engineering experience, REQUIRED by British Company for Spain.—Write, stating salary required and particulars of previous experience, "S. E.," c/o Streets, 6, Gracechurch-street, London, E.C. 3. 2540 A

WANTED, an Experienced LIFT DRAUGHTSMAN, with knowledge of estimating and sales correspondence.—Address, 2523, The Engineer Office. 2523 A

WANTED for Cement Machinery Manufacturers, DRAUGHTSMEN experienced in the design of Cement Machinery and Plant. Only those with this experience need apply.—Address, giving age, salary, and experience, 2440, The Engineer Office. 2440 A

WANTED IMMEDIATELY, a First-class DRAUGHTSMAN, design of Heavy Machinery and Structural Steel Work. Must have good experience and first-class references. London area. State salary required.—Address, 2536, The Engineer Office. 2536 A

WANTED, LEADING DRAUGHTSMAN, to Take Charge of Small Drawing-office in Glasgow district, experienced in Tarmacadam Plants, Tanks, and General Engineering. Excellent opportunity for keen man. State experience and salary.—Address, 2511, The Engineer Office. 2511 A

CHIEF DRAUGHTSMAN WANTED, Familiar with latest shop methods and design of General and Hydraulic Machinery. Age about 30-35; energetic and with ability to control and organise. Permanent position and good prospects. Salary about £8.—Address, with details of experience, 2506, The Engineer Office. 2506 A

DRAUGHTSMAN DESIGNER REQUIRED, Experienced in the design of Modern High-speed Machinery. A knowledge of Woodworking Machinery would be an added recommendation.—Apply, giving full particulars of age, education, experience, and salary required, to D.D., c/o Harris Lebus, Finsbury Works, Tottenham, N. 17. 2554 A

SITUATIONS OPEN (continued)

DRAUGHTSMAN.

JUNIOR ENGINEERING DRAUGHTSMAN REQUIRED temporarily for Railway Engineer's Office in London; experience in Permanent Way and Surveying essential.

Address, stating age, experience, and salary required, 2525, The Engineer Office. 2525 A

DRAUGHTSMEN, Permanent, WANTED, Co. Durham. Must be thoroughly live and competent men. Accustomed Coal-handling Plant Apparatus, Elevators, Conveyors and Chute Development with economic Structural Design experience.—Address, stating experience, age, and wage expected, 2517, The Engineer Office. 2517 A

DRAUGHTSMAN, Practical and D.O. Experience. Designing for economic production small high-class mechanisms, pressure gas control apparatus, &c. State age, experience, wages required.—Address, 2479, The Engineer Office. 2479 A

DRAUGHTSMAN REQUIRED for Leading Automobile Concern, Coventry district. Give fullest particulars, including experience, age, and salary required.—Address, 2370, The Engineer Office. 2370 A

DRAUGHTSMAN REQUIRED for Preparing Layouts of Machinery and Materials Handling Equipment.—Write, stating age, salary required, and qualifications, to FRASER and CHALMERS, Central House, Kingsway, W.C. 2. P5988 A

DRAUGHTSMAN, Senior, WANTED, Experienced in design and detailing of Structural Steel Work. Only first-class men need apply.—State age, experience, salary, and how soon could commence, to HORSELEY BRIDGE and ENGINEERING CO., Ltd., 85, Lionel-street, Birmingham (mark reply "Reference A"). 2494 A

DRAUGHTSMAN WANTED, Young Man Used to detailing Structural Steel Work under supervision. Must have sound theoretical knowledge and training.—State age, salary, and full particulars of experience to HORSELEY BRIDGE and ENGINEERING CO., Ltd., 85, Lionel-street, Birmingham. (Mark reply "Reference B.") 2495 A

DRAUGHTSMAN, with Experience of Power Transformers.—Apply, stating age, experience, and salary required, to MANAGER, Drawing-offices, B.T.H. Co., Ltd., Rugby. 2508 A

DRAUGHTSMEN for Structural Steel Work REQUIRED by London Firm; with previous similar experience. Permanency for right men. Full particulars, age, salary, experience, &c.—Address, 2546, The Engineer Office. 2546 A

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For continuation of Small Advertisements see page 4.

A Seven-Day Journal

The Fastest Train in the World.

THE Great Western 2.30 p.m. express from Cheltenham to Paddington always has been a fast train. In pre-war days it ran non-stop from Kemble to Paddington, 91 miles, in 103 minutes, or at an average speed of exactly 53 m.p.h. When the train service became more normal after the war a stop at Swindon was given, and it ran thence to Paddington, 77¼ miles, in 85 minutes, or an average of 54·53 m.p.h. On July 6th, 1923, ten minutes were taken off the running between those points, and the train was then timed to arrive at Paddington at 5 p.m. That necessitated the 77¼ miles being covered in 75 minutes, and thus at an average speed of 61·80 m.p.h. When, on September 24th last, there was a general great reduction in the train services, this train was entirely withdrawn. It is now restored in the present summer time table, which came into force on Monday last, July 8th, and is timed to arrive at the pre-war time of 4.55 p.m. The 77¼ miles from Swindon have to be covered in 70 minutes, or at an average speed of 66·21 m.p.h., making this train the fastest in the world.

Retirement of Mr. Summers Hunter.

AT the annual meeting of the North-Eastern Marine Engineering Company, Ltd., on Monday, the chairman, Mr. Summers Hunter, intimated that owing to advancing years he had relinquished the position of managing director at the end of last year, and that he was now retiring altogether from active service. The directors, he added, had elected Mr. H. R. Murray-Philipson to succeed him in the chair, and his eldest son, Mr. Summers Hunter, jun., had been appointed to the position of managing director. Mr. Hunter joined the North-Eastern Marine Company in 1880, and after passing through the various grades of management was elected a director in 1899. He was appointed managing director in 1900, and became chairman in 1920. Mr. Hunter played a prominent part in the work done by the company in the production of marine superheating apparatus and oil engines, and in the field of metallurgy he was responsible for the production and use made of Lanz "perlit" iron and other metals in marine engineering. During the war Mr. Hunter served on various Government committees, including the committee appointed by the Board of Trade for dealing with shipping and shipbuilding after the war, the Bulkheads Committee, the Shipping Controller's Committee, the North-East Coast Armaments Committee, and the Tyne and Wear Board of Management of the Ministry of Munitions for Shell Production.

Another Submarine Tragedy.

FOR the fifth time since the war the nation has to lament the loss of a British submarine and the heavy death-roll which is the invariable concomitant of these tragedies. On Tuesday morning, July 9th, the "H 47," of the Sixth Submarine Flotilla, while exercising in the Irish Sea with other craft of her type, came into collision with "L 12" in a position about 20 miles due west from Fishguard, and apparently sank immediately. The commanding officer, Lieut. R. J. Gardner, R.N., a telegraphist petty officer and a stoker petty officer were saved, but the other members of the crew, twenty-one in number, perished. Two of the crew of "L 12" are missing and one has died from injuries. The lost boat, which was built at Dalmuir in 1918, belonged to a large class of small submarines constructed under the war programmes. She displaced 440 tons on the surface, was 170ft. in length, and had oil engines of 240 B.H.P. As a class the "H" boats proved very successful and have always been popular with the Navy. Each year since the war, except 1928, there have been accidents to British submarines, generally with loss of life more or less severe. The "K 5," "H 42," "L 24," and "M 1" foundered with all hands. Abroad there has been an even larger crop of such peace-time casualties, notably the American boats "S 51" and "S 4," two large Japanese submarines, the Italian "Veneiro" and "F 14," and the French "Ondine." As early as Tuesday afternoon it was officially announced that all hope of rescuing the men imprisoned in "H 47" must be abandoned. As the vessel lies in 50 fathoms it is doubtful whether she will ever be brought back to the surface.

The Steam Table Conference.

AFTER a welcome by the President of the Institution of Mechanical Engineers on Monday last, the delegates from the countries which are taking part in the International Steam Table Conference met in the Council Room of that Institution under the chairmanship of Sir Richard Glazebrook and their labours will probably continue throughout the week. The proceedings are being conducted *in camera*, but at a dinner given by the British Electrical and Allied Industries Research Association on Wednesday night, with Mr. C. P. Sparks in the chair, some indication of their nature was given in an admirable speech by Dr. H. N. Davis, of the American delegation, and from general conversation with those taking part we are able to say with confidence that there is every prospect of a *via media* which will be acceptable to all the nations concerned being found. A very ingenious plan which leaves flexibility for improvement in the accuracy of steam tables as greater knowledge is acquired has been evolved, and seems likely to be put forward in due course by the Conference. We must not say what it is, but it seems to us to offer a real solution of the present difficulties. At the dinner we could not fail to be struck by the general atmosphere of international harmony that prevailed. We look upon it as a good augury, and believe it foreshadows a successful issue.

The Kelvin Medal, 1929.

THE Kelvin Medal Award Committee of the Institution of Electrical Engineers, after considering representations received from leading engineering bodies in all parts of the world, has awarded the Kelvin Medal for 1929 to Monsieur André Blondel (France). The Kelvin Medal is awarded as a mark of distinction in engineering work and investigation of the kinds with which Lord Kelvin was especially identified. Monsieur André Blondel, as engineer of the Ponts et Chaussées since 1889 and for many years the chief engineer of the French lighthouse services, is distinguished for his work on signalling apparatus, both optical and electrical, and particularly for his investigations in connection with electrical measuring apparatus and photometry. In 1913 he became a member of the Academy of Sciences and in 1923 was appointed Inspecteur Général des Ponts et Chaussées. He is regarded by French electrical engineers as their most distinguished member, and is an honorary member of both the British and American Institutions of Electrical Engineers. This is the fourth triennial award of the medal, which has in previous years been given to Dr. W. C. Unwin (Great Britain), Professor Elihu Thomson (U.S.A.), and the Hon. Sir Charles A. Parsons (Great Britain).

The Cold Working of Steel.

ON Saturday, July 6th, a new laboratory at Sheffield University, dedicated to the study of the cold working of steel, was opened by the Master of the Worshipful Company of Ironmongers, and the presentation of a cold-rolling mill and a wire and bar drawing plant was made by the Cold Rolled Strip Manufacturers' and by the Iron and Steel Wire Manufacturers' Association to the Cutlers' Company of Hallamshire, the machinery being handed over to the University by Mr. Percy W. Lee, the late Master Cutler. This provision for research on the cold-working of metals has been made possible by the generosity of the Ironmongers Company, which has endowed a research fellowship, and to the initiative of Mr. Percy W. Lee, who has been responsible for obtaining the necessary machinery. The plant consists of a cold-rolling mill, of the latest type built by W. H. A. Robertson and Co., Ltd., Bedford. This mill has hardened steel rolls 10in. diameter by 10in. face, and is driven by a variable speed motor which gives any rolling speed from about 60 f.p.m. up to 320 f.p.m. An alternative set of rolls fitted with "Skefko" roller bearings has been supplied. The two pairs of steel rolls have been presented by Messrs. Hadfields and Messrs. Firth, of Sheffield. The roller bearings were the gift of the Skefko Ball Bearing Company, of Luton. The wire and bar drawing plant by Geo. Crossley, Ltd., Cleckheaton, is equipped to draw all sizes of wire up to ⅜in. diameter and bars up to 1in. diameter. Both the mill and the drawing plant are full size machines as used in modern works, and are capable of rolling and drawing metal on a practical scale. Besides forming a training ground for the wire and cold-rolling industry, it is hoped that the research carried out on the subject, which has hitherto received little attention, will be of the greatest value to Sheffield and to the industries of the country.

Kent Coalfields Development.

AMBITIOUS plans for the development of the Kent coalfields were outlined by Mr. R. Tilden Smith on Saturday of last week. Opening a *fête* held in connection with Tilmanstone Colliery, Mr. Tilden Smith said that a new seam of coal—the Tilmanstone No. 2 seam—had been struck that morning. It was proposed to install machinery for treating the coal by a process of low-temperature carbonisation and to make the gas product available for domestic consumption. Included in the expansion policy, Mr. Tilden Smith continued, was the acquisition of several gas companies in the county of Kent, a controlling interest having been already secured in the East Kent Gas Company, which had distribution rights over an area of about 200 square miles. These undertakings would be supplied with gas in bulk from the colliery carbonisation plant. A further stage in the development scheme would include the erection of an electric generating station, either at Dover or in the vicinity of the colliery, having an output of between 100,000 kW and 200,000 kW. Industries requiring electricity would be created, and it was intended to erect cement factories, the raw material for which was already under the company's control. The latest reports from the experts, Mr. Tilden Smith added, indicated that the best and most undisturbed part of the Kent coalfield lay in the Tilmanstone area, it being estimated that over 1000 million tons of coal were to be found in the district covered by the colliery's present organisation.

Weak Bridges.

THE Minister of Transport has caused a circular to be issued to all highway authorities in Great Britain drawing attention to the provisions of the Bridges Act, 1929. The main provisions of this Act are designed to facilitate the procedure for the reconstruction of weak bridges in private ownership—for example, in the ownership of railway companies, canal companies, &c. Many of these bridges, as is well known, are not fitted to carry modern traffic, and the restrictions which their owners are authorised by law to impose on their use by heavy vehicles have caused considerable inconvenience and loss to trade and industry. In the circular the Minister expresses the hope that full advantage will be taken of the opportunity provided by the Act for the systematic improvement or reconstruction of the many weak or inadequate privately owned bridges on important roads. He states that in cases where a highway authority assumes an additional liability in respect of the reconstruction or improvement of such a bridge, grants can be made from the Road Fund in approved cases up to 75 per cent. of the net cost falling on the highway authority; that is, the cost falling on the authority after the deduction of any payments made by the owner of the bridge or other parties. The Minister draws special attention to the opportunity which such reconstruction work would afford for increasing the volume of employment and expresses his belief that local authorities will have regard to this aspect of the matter.

The General Electric Company.

AT the General Electric Company's recent general meeting Sir Hugo Hirst announced that he proposed to ask Mr. Railing, who has been general manager of the company for the past eighteen years, to be joint managing director with him. In making this announcement he referred specifically to the responsibility which had rested upon Mr. Railing whilst he (Sir Hugo) was on a Government mission in Australia. We understand that the announcement was well received by those who attended the meeting, and that Mr. Railing has since received numerous congratulations from members of all sections of the electrical industry. During the thirty-eight years Mr. Railing has been with the company he has witnessed an enormous increase in the business. The original capital and staff have been multiplied many times, and the company's activities have been extended to all parts of the world. New branches of the firm have been established at home and overseas, the original works have been greatly enlarged, additional factories have been acquired, and several subsidiary companies have been amalgamated into one centralised organisation.

Coal Petrol Developments.

SPEAKING at a luncheon given in Doncaster on Friday, July 5th, before the official opening of the new coalite carbonisation works at Askern Colliery, Lieut.-Colonel W. A. Bristow, managing director of Low Temperature Carbonisation, Ltd., said that by the coalite carbonisation process there was obtained from each ton of coal about 18 to 20 gallons of crude oil and 2½ to 3 gallons of petrol. The crude oil could be distilled or cracked to yield a further quantity of petrol and a yield of fuel oil and other products which would fetch a price higher than the cost of the coal. It was a very remarkable fact, he declared, that petrol made from coal was actually superior to petrol made from crude petroleum. A complete distillation plant of the most modern type would be finished at the coalite works at Barnsley by the end of the month, and arrangements had been made for cracking crude oil on a commercial scale at the works now being erected by Petroleum Refineries, Ltd., at Killingholme on the Humber. Some people seemed to think, he continued, that the development of the home oil market would be accompanied by fierce warfare with the existing British oil companies, and that one side or the other would perish in the struggle. Nothing, however, could be further from the truth. There already existed the most happy working arrangements between the oil trade and those producing motor spirit from coal. He particularly thanked the Anglo-Persian Company for the assistance it had given in the refining and preparation of some of his company's first coal petrol, and for the sympathy it had always shown towards the company's programme. Such treatment was typical of the attitude displayed by the responsible men in the industry, and he saw no reason whatever to fear internal hostility towards the production of British crude oil. The ultimate output of the new plant will be 127,000 tons of coalite smokeless fuel per year, and 3,731,000 gallons of oil and petrol per year.

Transformer Tap-Changing on Load.

No. I.

DURING April and May of 1926 we published a series of articles on alternating-current pressure regulators, as used, for instance, for the control of transmission power factor in an interconnector between two power systems. The prominence which was being given about that time to the advantages of interconnection seemed to indicate that a series of

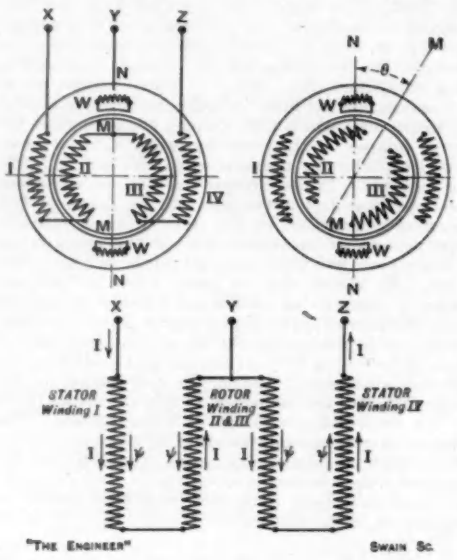


FIG. 1—REGULATOR WINDING DIAGRAM

articles of that nature might prove useful and descriptions of all the regulators available and suitable for all kinds of service, including the regulation of rotary converters, were consequently published. In the third article of the series, published on April 30th, reference was made to the rapidly increasing use in America of transformers designed for tap-changing on load, but at the time none of the British manufacturers appeared to make this equipment; at any rate, all the information that reached us related to other methods of regulation. In the following year, however, we were invited by Ferranti, Ltd., to inspect

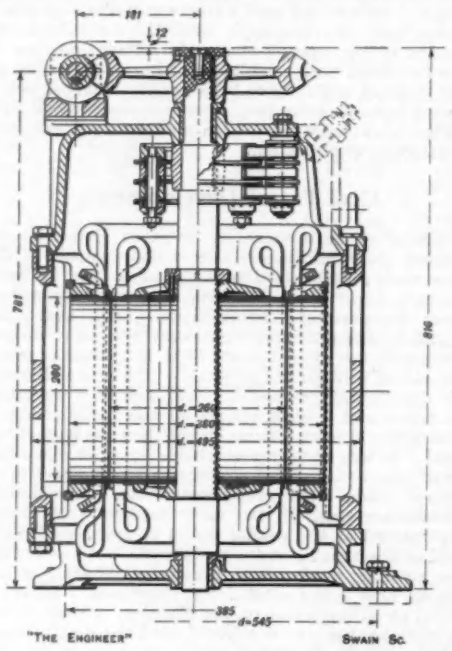


FIG. 2—SECTION THROUGH REGULATOR

some transformers fitted with on-load tap-changing gear at Bow, and an article describing them appeared in our issue of August 26th of that year. Reference to that article will show that important advantages are claimed for this system of voltage regulation, such as relatively low initial cost, low cost of cabling and erection, small floor space, high overall efficiency, and high speed of operation. In a later article of the present series we shall deal with the more recent work of this firm, which, in common with others, has now built some large on-load tap-changing transformers for the British grid. All the large electrical firms, in fact, are now actively engaged upon the design and construction of these transformers, which are destined to play an important part in the national electricity scheme. In our previous series of articles we referred to two methods of changing the tappings of transformers, whilst they are under load, *i.e.*, the split parallel winding or inherent reactance method, as used on the Ferranti transformers at Bow, and the

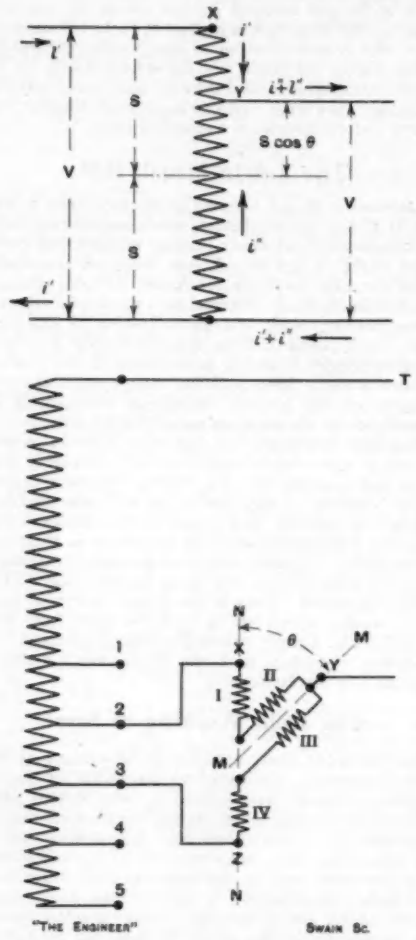


FIG. 3—THEORETICAL DIAGRAM OF REGULATOR

single-winding method, involving the use of a mid-point tapped reactor to enable the transfer to be made from one tapping to the other without breaking the main circuit. These are the two methods that are commonly adopted, but one firm—namely, the Hackbridge Electric Construction Company, Ltd.—employs a rather more elaborate scheme, which we shall now consider. We hold no brief for any particular system or form of construction, and the order in which the descriptions of different equipments appear must not on any account be taken as an indication of the importance we attach to them.

THE HACKBRIDGE-STRAGIOTTI SYSTEM.

The Hackbridge transformer tap-changing system for on-load voltage control is the invention of Pietro Stragiotti, an Italian engineer, and the principal technical feature of the invention is the use of a variable ratio auto-transformer constructed on similar lines to an induction regulator. The system is particularly suitable for use when small voltage steps are required, and when it is desired to control the gear automatically. With automatic control, the makers explain, the number of tap-changing operations is usually greater than with manual or push-button control, so that there is more burning and wear on the switching contacts which form part of the equipment. The regulator under consideration, however, saves wear and tear on the switching contacts and gives very smooth regulation. Where station busbar or transmission line regulation is required the smoothness of control is important from the point of view of electrical stability. In effect, the regulator is an auto-transformer with a variable ratio, and is constructed on similar lines to an induction regulator, with a stator and rotor and a single distributed winding on the two cores. The regulator is inserted between two adjacent tappings of an ordinary transformer, and a gradual change in the voltage between one tapping and the other is brought about without interrupting the circuit. There are two methods of applying the regulator to a transformer. One is to employ a regulator which can remain in circuit continuously, thus making it possible to stop the regulation at any desired point and to obtain an infinitely variable ratio over the range of tappings; whilst the other is to employ a smaller regulator that can only remain in circuit for a short time, and in that

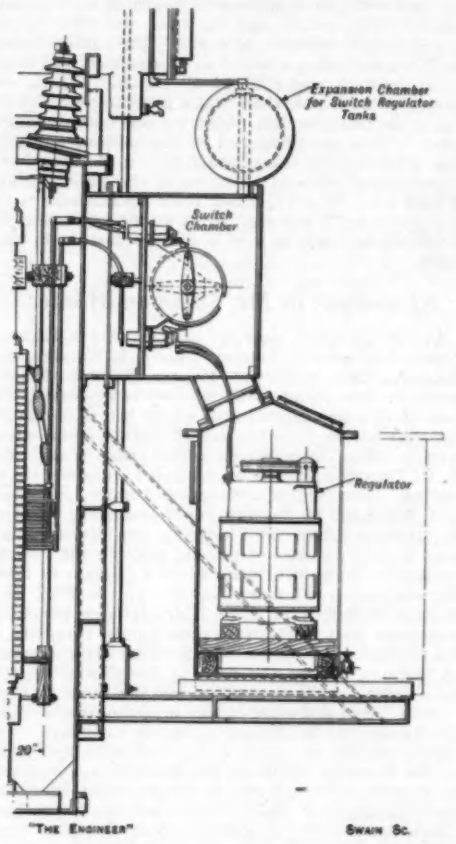


FIG. 4—GENERAL ASSEMBLY OF 10,000-kVA UNIT

case the voltage steps will, of course, be governed by the transformer tappings, but the regulation will, nevertheless, be perfectly smooth. It is more economical to adopt this scheme, involving the use of a short rated regulator, which is cut out of circuit when the step has been completed. With this method, the only additional loss is that introduced by the regulator during the short time necessary to change over from one tapping to another.

A diagram of the windings of the regulator is given in Fig. 1; whilst a section through a four-pole regulator is shown in Fig. 2. There are four sets of coils, I.–IV. Those marked I. and IV. are stator windings, whilst the other windings II. and III. are on the rotor. The terminals are marked X, Y, Z. The internal connections are self-explanatory, and it is

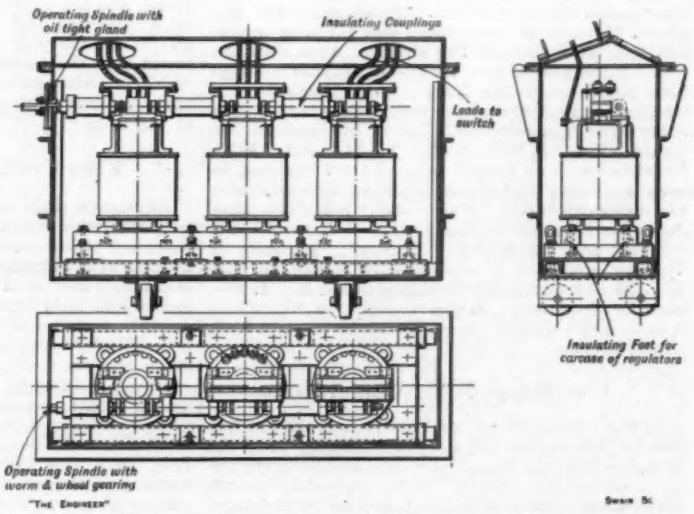

Operating Spindle with oil tight gland
Insulating Couplings
Leads to switch
Insulating Feet for carcase of regulators
Operating Spindle with worm & wheel gearing
"THE ENGINEER"
SWAIN Sc.

FIG. 5—DETAILS OF 3-PHASE REGULATORS

evident that the connections between the windings I. and II. and III. and IV., and between the rotor and terminal Y are made through brushes and slip

rings. The windings I. and IV. are wound in the same direction, so that current passing from X to Z will generate flux of equal magnitude in each winding,

FIG. 6—3-PHASE GROUP OF REGULATORS

and will act in the same direction, whilst windings II. and III. are wound, so that, with current flowing from X to Z, magnetic fluxes of equal magnitude, but in opposite directions, will be generated. On the stator there are additional windings W in quadrature with the stator windings I. and IV., and composed of a low resistance short-circuited coil.

The variation of the interlinkng of the stator and rotor fluxes is dependent upon the position of the rotor in relation to the stator winding, and this magnetic interlinking is best understood by a consideration of the magnetic axis of the stator coils N N, and that of the rotor coils M M. Assuming a two-pole regulator, as shown in the diagram, with

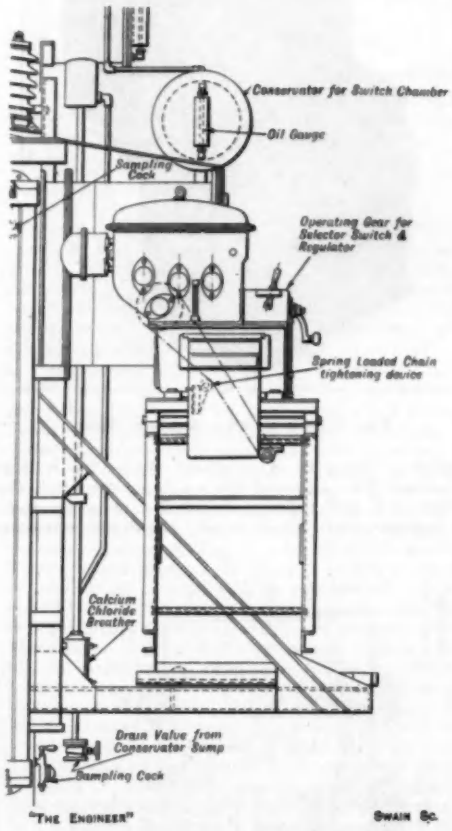


FIG. 7—REGULATING GEAR MOUNTED ON TRANSFORMER

an alternating voltage V applied between terminals X and Z, with the rotor in the position where the angle of displacement $\theta = 0$ deg., the flux of the rotor winding II. and that of the rotor winding III. will be added arithmetically to the flux of stator winding IV. Assuming the next position of the rotor to be diametrically opposed to the foregoing position, so that $\theta = 180$ deg., the flux of stator winding I. and rotor winding II. will be added, and the flux of the rotor winding III. and the stator winding IV. will neutralise each other. The short-circuiting winding W is provided for the purpose of neutralising the components of the stator flux in phase with N N. These components vary with different values of current flowing through the winding sections. With the same current passing through stator windings II. and III., they are of equal value, and opposed sign, but with different current flowing through these sections, such as arise when the short circuiting switch is closed between Y and X or Z, the resultants are of different value, and under this condition this leakage resultant flux is compensated for by winding W. For the intermediate positions of the rotor, the flux of the rotor winding II. will be proportional to $-\cos\theta$, while that generated by the rotor winding III. will be proportion to $+\cos\theta$. Assuming therefore that each winding has T number of turns, then the equivalent number of turns of X Y will be $T - T\cos\theta$, and that of Y Z, $T + T\cos\theta$, making a total of 2 T for the whole of the regulator winding connected to the terminals X Z. If the values of cosine θ for 0 deg. and 180 deg. be inserted in the above expression, cancellation and arithmetical summation may be verified. An effective winding, which consists of a constant number of turns, is therefore obtained, and it maintains a constant characteristic across its terminals X and Z with a variable characteristic between terminals X Y and Z Y, depending upon the rotor position, this being equivalent to an auto-transformer illustrated in the upper part of Fig. 3.

The application of the regulator to a single-phase winding with several tappings is shown in the lower diagram, Fig. 3, where it will be seen that the regulator is connected between the two adjacent tappings of the winding, the main terminals of which are T and Y. Let us consider the operation of changing over the tapping No. 2 to No. 3. Assuming $\theta = 0$ deg., the stator winding I. and rotor winding II. will have equal and opposing fluxes, and the reactance of X Y is nominally zero. Hence, there will be no potential difference between X and Y, so that the potential between T and Y will be proportionate to the voltage ratio between T and tapping No. 2. The rotor winding III. and the stator winding IV., however, will have fluxes of the same polarity, and, therefore, the reactance of Y Z will be at a maximum. Under these conditions, the windings III. and IV. will only pass the magnetising current of the induction regulator, the circuit between tapping No. 3 and Z being closed. Thus it will be seen that it will be possible to open the switch connecting tapping No. 3 to the terminal Z, and to connect Z to tapping No. 1, the only load broken being the magnetising current of the regulator. Assuming now that, with the connections made, as shown in the diagrams, across tappings Nos. 2 and 3, the rotor is rotated 180 deg. The potential between Y and T would then be the same as between tapping No. 3 and the terminal T. The stator winding I. and rotor winding II. would have fluxes of the same polarity, and the rotor winding III. and stator winding IV. would have fluxes

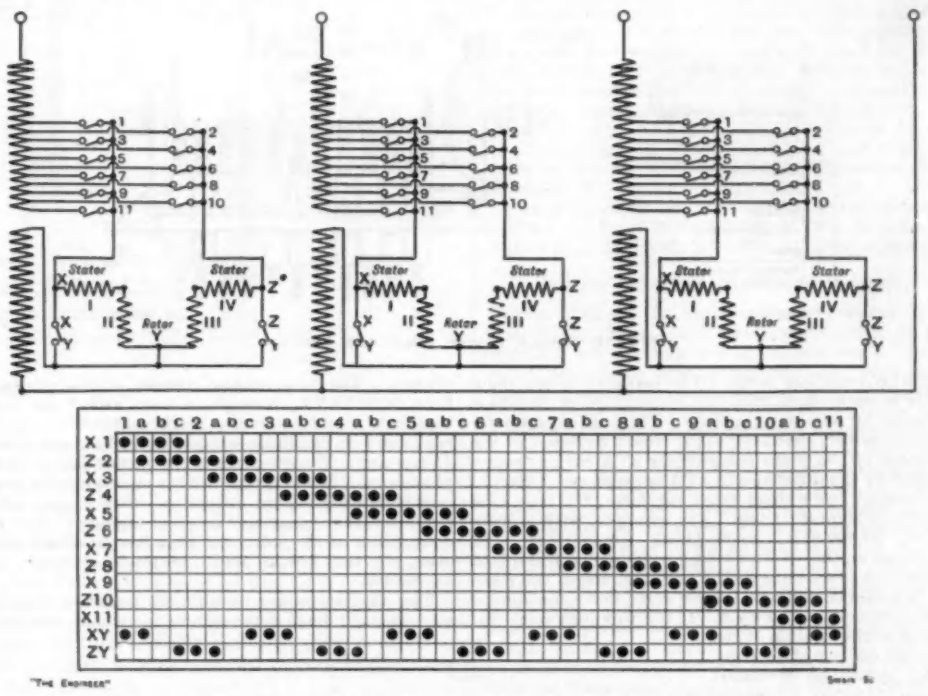


FIG. 8—REGULATOR CONNECTIONS AND SEQUENCE DIAGRAM

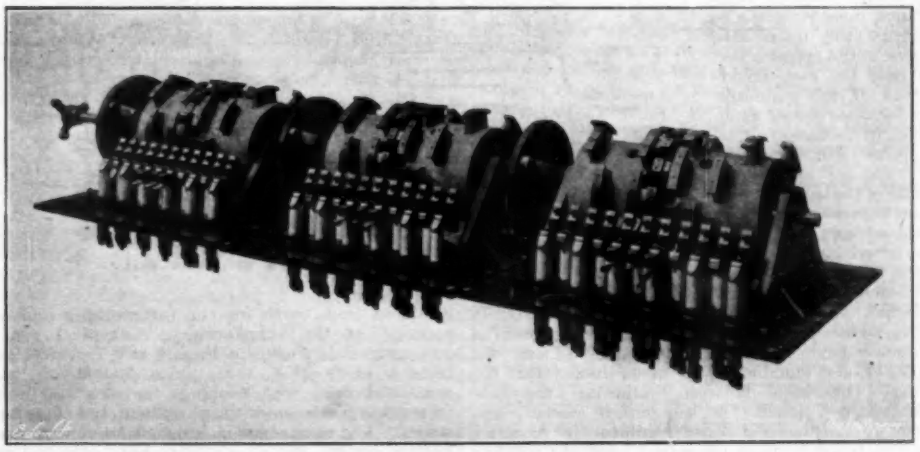
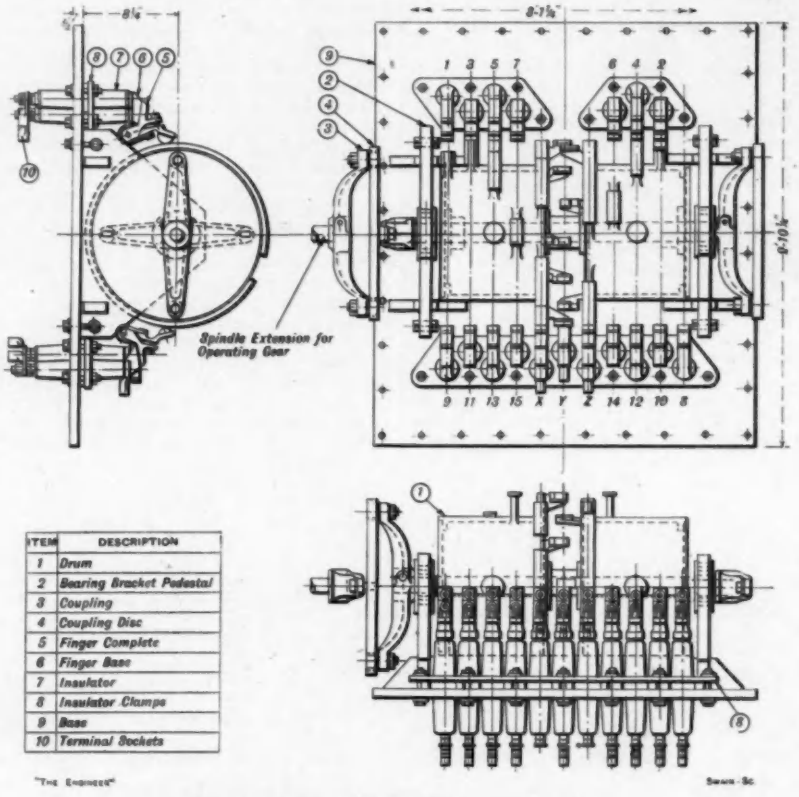


FIG. 9—3-PHASE SELECTOR SWITCH

of opposite sign. Thus, the reactance of Y Z would be nominally zero, and that of X Y a maximum. It would then be possible to disconnect tapping No. 2 from X, as in this case, also, only the magnetising current of the regulator would have to be ruptured, and it would then be permissible to connect X to tapping No. 4 in the preparation for a further change of ratio. Obviously, with the operation of the regulator rotor at each step, the entire range of tappings can be covered in either direction. As stated at the outset, with a continuously rated regulator, the rotor can be locked in position at any intermediate step between tappings, thus giving extremely fine regulation over the whole tapping range. The capacity of the regulator is dependent upon the percentage of variation effected by adjacent tappings. The true capacity for a continuously rated regulator would be equal to the fraction of the main transformer kVA rating, represented by the difference in kVA between two adjacent tappings. For a short rated regulator, the true kVA would be somewhat less. For example, with a 5000-kVA, 20,000-volt, single-phase transformer with tappings on the H.T. winding to give plus and minus 5 per cent. variation with 1 per cent. steps, the regulator would be designed for 200 volts, and a continuous rated capacity of 50 kVA. If the tappings were disposed in the middle of the leg, the carcase of the regulator would be insulated for an operating voltage of 20,000 above earth.

The switchgear for connecting and disconnecting the regulator from one tapping to another is not called upon to perform very heavy duty, as in no instance does it break or interrupt the main load current of the transformer, but only the magnetising current of the regulator. For delta-connected windings or in the case of a star-connected winding where the tappings are in the middle of the leg, the frame of the regulator is suitably insulated from earth. It is to be noted that the carcase of the regulator is always maintained at a definite potential, as the terminal Y is connected solidly to the carcase and therefore the greatest potential difference between the carcase and Y and the insulated slot conductors is never more than the voltage difference between adjacent tappings. This feature permits of economical design, and where a continuously rated regulator is required, it solves the difficulties attendant upon the winding of slot conductors insulated for operation directly in E.H.T. circuits. The insulation of the windings from the frame does not therefore offer any greater difficulties than with the insulation of ordinary low-voltage motors, and this applies in the case of the highest operating voltages of the main transformer. The major insulation of the regulator is obtained by mounting the carcase on a special insulating frame inside the oil-filled containing tank. A section of insulating shafting, similar to the sections between phases, provides the insulation on the end section of the worm operating shaft connected to the external operating sprocket. The illustration, Fig. 4, shows the insulating cradle which is made of dried and impregnated wood, exhaustive tests having shown that properly treated wood has excellent mechanical and electrical properties and perfect chemical stability. The drawing, Fig. 5, and the engraving, Fig. 6, show the insulating couplings between phases. The magnetising current of the regulator for a 10,000-kVA, three-phase unit, with 1 per cent. tappings, would be in the neighbourhood of 15 per cent., and its reactance would also be between 12 and 15 per cent. The effect upon the power factor or the phase angle of the current with a continuously rated unit is an insignificant quantity. With a short-rated regulator, the equipment is short-circuited after the completion of the step, and thus has no effect whatever on the phase angle between primary and secondary.

The regulators are usually oil-immersed with an oil-immersed drum-type switch, the whole gear being insulated from earth for the full working and test pressure of the transformer. A typical general arrangement is shown in Figs. 4 and 7, which illustrate a 10,000-kVA, three-phase, 33,000-volt, star-connected unit, with tappings for plus and minus 10 per cent. variation with approximately 1·4 per cent. steps. The equipment is designed for remote push-button control, and an auxiliary hand-operated gear is provided for testing purposes. Two equipments of a similar nature are now being constructed for completely automatic operation with voltage relay control. The regulators in this case are designed for intermittent rating. Below the diagram of connections, Fig. 8, there is a chart giving the sequence of operations of the switches. It will be noticed that there are additional switches, namely, X Y and Z Y, which perform the function of short circuiting the section of the regulator which operates in series with the tapping and terminal Y. The sequence of operation is as follows :—Assuming the transformer is operating on No. 1 tapping, the regulator windings I. and II. are short circuited by switch X Y, the regulator being in a position where $\theta = 0$ deg. Windings Nos. III. and IV. are open circuited, the switch Z Y and tapping switch No. 2 being open. To change over to No. 2 tapping, the first operation is for switch No. 2 to close, thus connecting Z to No. 2 tapping. Next, switch X Y opens and removes the short circuit across windings I. and II. Windings III. and IV. are then in the position of maximum impedance. The regulator is then caused to rotate



ITEM	DESCRIPTION
1	Drum
2	Bearing Bracket Pedestal
3	Coupling
4	Coupling Disc
5	Finger Complete
6	Finger Base
7	Insulator
8	Insulator Clamps
9	Base
10	Terminal Sockets

FIG. 10—SINGLE-PHASE SELECTOR SWITCH

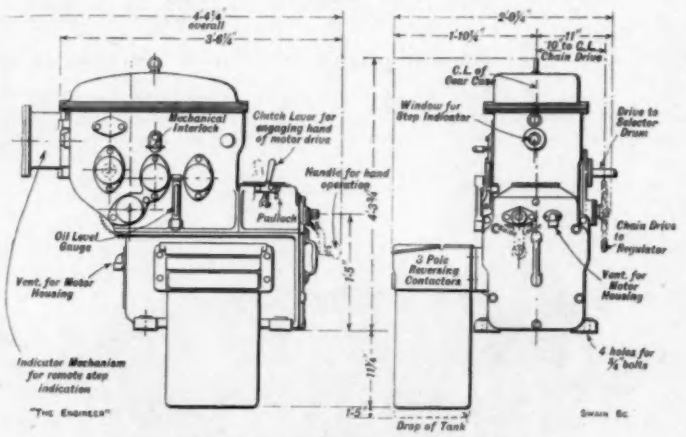


FIG. 11—SIDE AND END VIEWS OF GEAR-BOX

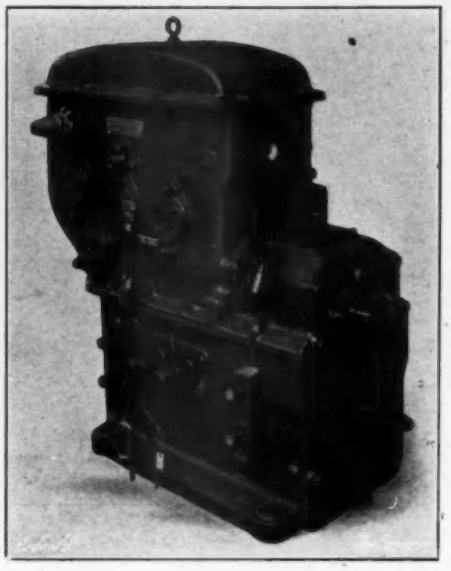


FIG. 12—GEAR-BOX

FIG. 13—GEAR-BOX—SWITCH SIDE

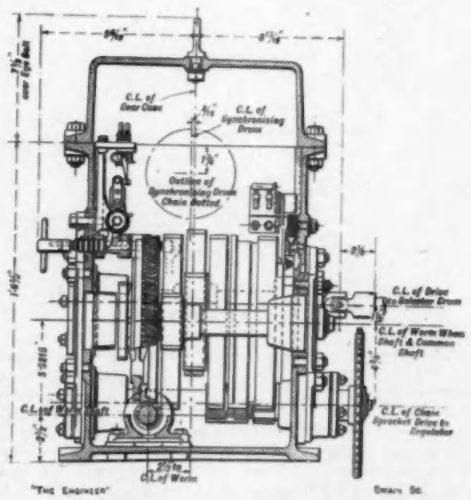

C.L. of Gear Case
C.L. of Synchronising Drum
Outline of Synchronising Drum Chain Behind
C.L. of Drive to Selector Drum
C.L. of Worm Wheel Shaft & Common Shaft
C.L. of Chain Sprocket Drive to Regulator
C.L. of Worm
"THE ENGINEER"
Swain Sc

FIG. 14—SECTION THROUGH GEAR-BOX

through 180 electrical degrees until $\theta = 180$ deg., and the switchgear then comes into operation again, and closes switch Z Y which short circuits III. and IV. Switch No. 1 then opens and disconnects tapping No. 1 from X, and breaks the magnetising current of the regulator. With this particular unit the regulators have been wound with four poles, and to change over from one tapping to another the regulator has to operate through 180 electrical degrees, but only 90 physical degrees.

Each phase of the switchgear is mounted on a separate bakelite base with bakelite supporting brackets. The tapping fingers are mounted on each side of the drum in order to reduce the length to a minimum. Special care has been taken to prevent any movement or distortion. Even if the oil in the main transformer tank attains the maximum permissible temperature, and that in the switch tank a temperature that gives the maximum difference possible under operating conditions, the alignment of all the switchgear is maintained.

The illustration, Fig. 9, shows the complete three phases of the selector switch, which is mounted as shown in Fig. 4. The details of a single unit of the switch are shown in Fig. 10. The operating shaft of the switch extends through an oil-tight gland mounted in the tank, and is connected by a flexible coupling to the gear-box shown in Figs. 11, 12, and 13. Below the switch shaft on the gear-box there is a toothed sprocket which drives the regulator worm shaft through a roller chain, the internal train of gears in the gear-box controlling the operating sequence.

The gear-box casing, which has machined weather-proof joints, houses the gearing train in the upper compartment, and all the gear pinions run in an oil bath, whilst all the shafts run on ball bearings. The lower compartment houses the operating motor, and on the side of the motor-housing there is an oil-filled tank, which contains the switchgear controlling the motor and the reversing contactors for reversing the direction of rotation. A section of the gear train compartment is shown in Fig. 14, where it will be seen that in the upper part of the compartment there is a synchronising drum with a number of segments corresponding to the transformer tappings, and which is brought into use when two or more transformers are operating in parallel, and when it is desired to operate all the transformers simultaneously when changing from one tapping to another. To raise or lower the voltage of any number of transformers in parallel by an amount corresponding to one tapping, it is simply necessary to press a button. The system also permits of the simultaneous control of selected units in a transformer bank. Thus with a six-unit bank, for example, two or three units can be left to operate as separate units, the operating push-button on the control board for each transformer being used to raise or lower the voltage. The other transformers can be connected for synchronous control by the operation of a push-button. Whilst passing through a voltage step, the driving motor runs continuously, the intermittent drive of the switchgear, and subsequently the drive of the regulator being given by the special form of intermittent gearing, the pinions of which are locked in position between their operating periods. A section of the motor compartment and the hand-operating mechanism which can be brought into action by a throw-over dog clutch is shown in Fig. 15. Any part of the gear can be inspected without dismantling other parts, and the selector switches and regulators are easily disconnected or dismantled.

(To be continued.)

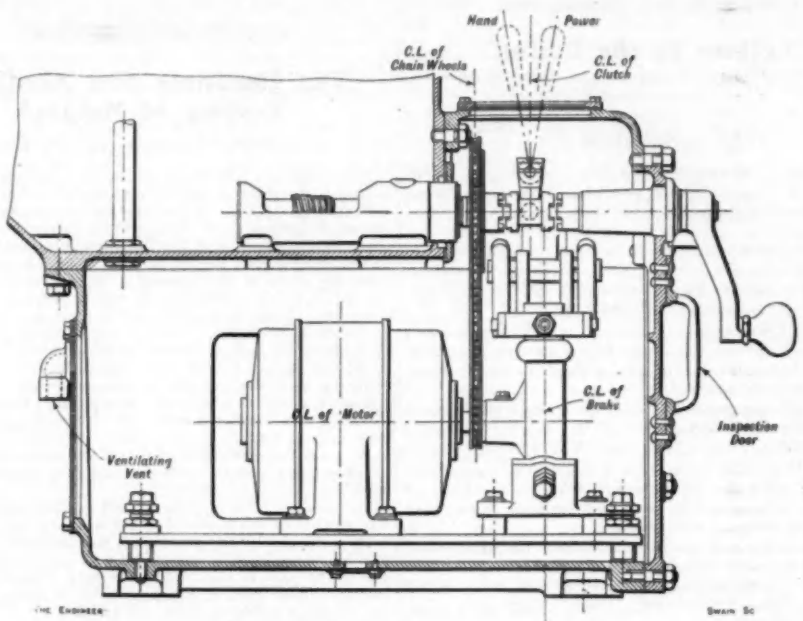


FIG. 15—DRIVING MOTOR AND CLUTCH

Report on London Waters.

WE have just received a copy of Sir Alexander Houston's Twenty-third Annual Report on "The Results of the Chemical and Bacteriological Examination of the London Waters for the Twelve Months ended December 31st, 1928."

Of recent years Sir Alexander has treated the readers of these reports of his to delicate pen pictures of the sources from which the metropolitan water supply is obtained. First he dealt with the New River, then with the Kent Wells, and in the last Report with the River Lee. In all three cases the story he had to tell was charmingly told and fascinating to read. Even bricks and mortar and dingy streets were made to appear things of beauty, while peeps of the country-side, as revealed in photographs, brought home to us what wealth of picturesqueness lies but a few miles of this Metropolis of ours. This year he has undertaken an even more onerous task. He presents—with much diffidence, as he informs us—a description of the Thames as a source of supply, confining his remarks, largely, to that portion of the river which lies between Kingston and Pangbourne. Even so, his subject is wide, and he has dealt with it as ably and as enthrallingly as with its three forerunners, and it will be read with the keenest pleasure by many who are not water supply experts or engineers, though a technical note has been included in the present thesis which was absent from those which have gone before it. As in the past, however, we must refrain from giving it more than this brief mention, merely adding that those who are fortunate enough to acquire a copy of the report will be more than repaid for their trouble when they peruse it, and study the numerous photographic gems which accompany it.

SECTION I.—CHLORINATION OF THAMES WATER.

With so much preface, we pass on to what we may term the "business portion" of the report. It is divided into ten Sections, the first of which deals with the Chlorination of Thames Water. The period covered by the report is the thirteenth year during which Thames water has been dealt with by this process. Never since it was begun in 1916 has there been a single instance of complaint as regards taste, though some 76 million gallons are treated every day and some 2,000,000 consumers are each supplied with an average of 38 gallons per day each. Apart from a large saving in coal consumption, since pumping into reservoirs is to a considerable extent lessened, there has, since the introduction of chlorination, been a marked increase in the number of million gallons of water filtered per acre of filter beds cleaned. In the worst case—that of Kempton Park—the increase was from 28·1 to 31·47 millions, and in the best—at West Middlesex—from 35·25 to 67·40, a rise of 32·55. As it costs some £40 to clean an acre of filter bed, it will be realised that the saving that has been effected is very considerable.

During the year an up-to-date liquid chlorine plant, installed at Hampton, took the place of the last remaining chloride of lime plant for chlorination on the Board's works. A new factor, too, was the utilisation of raw Thames water from the Staines Aqueduct for filtration on the Southwark and Vauxhall filters at Hampton. The water was drawn from the aqueduct at the outlet to the Littleton Reservoir, and passed down the Littleton conduit to Hampton, a special chlorination plant being erected at the Littleton outlet to deal with it. The average dose applied, in terms of available chlorine, was 0·42 part per million. The average cost of chemicals per million gallons treated worked out at 8·8d.

SECTION II.—CHLORINATION OF THE NEW RIVER.

Normally, the New River is only chlorinated during the winter months when the water deteriorates considerably in quality, owing, chiefly, to floods, the deficiency of storage accommodation, and, to some extent, to the filtration area being hardly adequate in size. Hence, although the annual reports are now based on the calendar and not the financial year, it was considered advisable that the period covered by the report should be from November, 1927, to March, 1928. Sir Alexander reports that the results obtained were rather remarkable. One hundred and four samples collected at Highfield, *before chlorination*, contained B. coli in 1 c.c.—or less—in 68·3 per cent. of the samples examined. The same number of samples collected at Wood Green, *after chlorination*, contained *no* B. coli in 100 c.c.—or one hundred times as much water—in 85·6 per cent. of the samples examined. At the outlet from the Hornsey reservoir the results were practically the same, *no* B. coli were found in 100 c.c. in 84·6 per cent. of the 104 samples. From the Stoke Newington reservoir the results were by no means so good, only 2·9 per cent. of the 104 samples showed no B. coli in 100 c.c. This phenomenon, remarks Sir Alexander, is no new feature, but the puzzle remains. "Do birds, fish, or other forms of life account for the discrepancy?" he asks. "Is it conceivable, as some have hinted, that chlorination dopes, but does not kill B. coli, and that apparently dead B. coli may gradually recover their vitality?" Laboratory experiments do not, he says, lend any support whatever to that hypothesis. "Is it possible," he asks again, "that unknown to the writer, adventitious water containing B. coli reaches the supply between Wood Green and the outlet from the Stoke Newington reservoirs?" "However this may be," he concludes, "the results are only disappointing in relation to the wonderful results obtained at Wood Green and at the outlet from the Hornsey reservoir. The main point is that the effects of the winter floods, as shown above Highfield, before chlorination, are practically effaced, in a bacteriological sense, by the chlorination process at that station, so that when the water reaches Wood Green it is literally transformed in quality."

It may be added that the total cost of the chemicals used in the New River treatment was £520·54, or at the rate of 1s. 10·8d. per million gallons treated.

SECTION III.—PRE-FILTRATION WATERS.

Since 1922 all the various kinds of water which "feed" the filters, and which are known as pre-filtration waters—raw water, stored water, gravel water, &c.—have been completely and thoroughly examined, chemically and bacteriologically, each week. Sir Alexander remarks that he "feels that the pulse of the metropolitan water supply is the condition of the pre-filtration waters," and he derives some most interesting information from these examinations. For example, he finds that there is an enormous improvement in the bacteriological quality in the raw Thames, Lea, and New River waters, consequent on storage. As an instance, he points out that as raw Thames water contained B. coli in 57·7 per cent. of the samples in 0·1 c.c.—or less—and as Chelsea *stored* water contained B. coli in 100 c.c. in 57·6 per cent. of the samples, it might be said that Chelsea stored water was improved 1000 times. Indeed, from the figures adduced, it is seen that nearly all pre-filtration waters are improved from 100 to 1000 times as compared with the raw river water. Moreover, it is impossible to store river water without certain physical and chemical changes taking place, and it is possible to read into these alterations of composition, indirect, but valuable evidence of what has taken place bacteriologically. It takes time to effect these physical and chemical changes just as it requires time for the destruction of pathogenic bacteria in water under conditions of storage. From the figures in the tables given in the report, it is obvious that the raw waters are, generally speaking, altered considerably in character by reason of storage, and that the percentage reductions for the various tests are not uniform, the tendency being for the ammoniacal nitrogen, turbidity, and colour tests—especially the first two—to show proportionately greater reductions than the albuminoid nitrogen and permanganate tests.

SECTION IV.—THE BARN ELMS EXPERIMENTS.

What are known as the Barn Elms experiments were instituted some years ago to test the effects of passing water, which had previously been treated in primary filters, through an ordinary sand filter at rates up to three times the customary London rate, which is rather less than 2 gallons per square foot per hour. For the purpose, the outlet of one of the filter beds was altered so that this increased rate of flow could be obtained. The chief questions which it was sought to answer were:—

(1) Would the filtrate from the altered bed compare favourably, or unfavourably, with the filtered waters generally, as judged physically, chemically, and bacteriologically?

(2) Would there be an increase, or a decrease, in

the "number of million gallons filtered per acre cleaned"?

(3) Would there be any evidence of a gradual, but progressive blocking of the interior of the filter, resulting in "the number of gallons filtered per acre cleaned" becoming less and less as time went on?

An adverse verdict regarding No. (3) would mean that practically the whole bed would have to be turned over and cleaned periodically, as, indeed, is the custom at some Works of the Board. In such a case, everything would depend upon the extent of internal blocking as a result of the "rushing" filtration tactics. So far as the test has been carried, it does not appear, according to the Report, that any progressive interior choking of the bed is foreshadowed. Furthermore, as the result of about fifty-two months' experience, it would seem that the following results can be obtained, assuming comparable conditions, by the methods employed at Barn Elms:—

(1) A final product practically as good, on the average, as that resulting from the ordinary slow filtration process.

(2) Comparative freedom from algal troubles, or those caused by an excess of suspended matters, owing to the useful work carried out by the primary filters.

(3) A considerably greater output of water per acre of filtration area, allowing for the space covered by the primary rapid filters, per unit of time.

It may be added that the primary filters have been worked at an average of 141 gallons per square foot per hour, while the experimental filter has been worked at an average of 4·42 gallons per square foot per hour, and has yielded 75·1 per cent. of first-class samples, *i.e., no* B. coli in 100 c.c. of water.

SECTION V.—WALTON WORKS.

At the Walton works, as our readers are aware, rapid filtration is followed by a filtration, at considerably more than the usual rate, through ordinary sand filters. Raw Thames water is first stored in Walton reservoirs, then filtered—without coagulant—through eighteen primary filters, working at the average rate of 112 gallons per square foot per hour. The next process is filtration through secondary filters working at the average rate of 5·61 gallons per square foot per hour. Finally, the water is chlorinated, the average dose being 0·207 part per million.

The results obtained, as set out in the Report, are as follows:—

BACTERIOLOGICAL (AVERAGE) RESULTS.

Number of Bacteria in Agar at 37 deg. C. per c.c.

A. Raw river water	275
B. Walton stored water	15
C. Mixed filtrates from one set of primary filters	18
D. Do. do. from other set of primary filters	21

Filtrates from the Six Secondary Filters Before and After (in brackets) Chlorination.

E. No. 1 Filter	2·8 (2·7)
F. No. 2 Filter	5·4 (4·3)
G. No. 3 Filter	3·3 (2·7)
H. No. 4 Filter	5·8 (4·3)
I. No. 5 Filter	3·4 (2·9)
J. No. 6 Filter	5·3 (4·9)
K. Final filtrate from the general filter well (mixture) of all the chlorinated waters	3·7

Percentage Number of Samples Containing No B. Coli in 100 c.c. (First-class Samples).

The results are given in the same order as in the foregoing:—

A. 0·0 (91·6 per cent. contained B. coli in 1 c.c. or less).
B. 34·5.
C. 45·0.
D. 51·4.
E. 92·3 (99·1).
F. 89·9 (100·0).
G. 83·2 (98·1).
H. 89·1 (100·0).
I. 93·9 (99·1).
J. 76·3 (93·5).
K. 96·4.

It is explained that the results, as regards A, B, C, D, and K are for the calendar year 1928. The results for E to J are for the period January 1st to November 9th inclusive; afterwards the place of chlorination was altered to allow for the addition of ammonia *before* chlorination, the mixed water from all the filters being chlorinated at one spot, before going to the general well.

"Bacteriologically, it would be hard to surpass these results," remarks the Report. "To change a water containing B. coli in 1 c.c. in 91·6 per cent. to one yielding no B. coli in 100 c.c. in 96·4 per cent. of the samples examined is a striking feat."

The Report gives much further interesting information regarding these works, and the experiments made with the filters, as well as several further tables. We can, however, only spare space to quote the final paragraph in this section: "In looking through these results many items catch the eye; for example, the very high rate of filtration in the case of the primary filters (112 gallons per square foot per hour). The high rate of filtration through the secondary filters (5·61 gallons per square foot per hour), having regard to the much lower rates commonly employed. Finally, the remarkably high number of million gallons filtered per acre cleaned (576 m.g.)."

SECTION VI.—RESISTANCE TO FILTRATION AND MICROSCOPICAL APPEARANCE OF THE PRE-FILTRATION WATERS.

Over twenty samples of pre-filtration waters of all kinds are examined each week, and a permanent record—qualitative and quantitative—of the suspended matters in them obtained by means of photographs. Sir Alexander's albums now contain just short of 15,000 pictures of the condition of pre-filtration waters taken over a period of thirteen years. From the experience gained by a study of them, it is possible to foretell, and to take measures to counteract the effects of, excessive algal growths. In past reports many excellent reproductions of microscopic photographs of these growths, nearly all of them beautiful in form, have been given. The Report remarks, however, that, beautiful as they are, they often indicate trouble in carrying out filtration processes.

The Report concludes with: Section VII.—"Meteorological Notes"; Section VIII.—"Search for 'Lactose O Dulcit + ' Microbes" in which group fall the paratyphoid bacteria; IX.—"Search for Pathogenic Microbes in Water"; and X.—"Miscellaneous," under which heading such subjects as "Paratyphoid Fever in London," "The Floods of January, 1928," "Gulls as a Source of Contamination of Water," &c., are discussed.

Finally, there come the usual Chemical and Bacteriological Tables, a subject index, &c.

Letters to the Editor.

(We do not hold ourselves responsible for the opinions of our correspondents.)

OLD CONTEMPTIBLES.

SIR,—Old Contemptible has my sympathy. I am another but luckier, and if you publish my experiences he may find some small comfort from them and perhaps do likewise.

In 1914 I was at the top of my tree, a high one, and came off it to vegetate. War put an end to the vegetation idea, and I started again at foreman's pay, my position rising but my unearned income dwindling.

By 1921 I was again on top, and in 1926, aged sixty, on the street through bad times and the want of patriotism of our Independencies, who prefer their pockets to their Empire's and my good.

Like your correspondent I tried for another job, making seventy-four applications, here is the result:—Seventy-four applications made; five interviews, sympathy, complaints of bad trade, but no results; eight letters answered, no result; sixty-one, no answer or acknowledgment. In forty-two of these stamps were sent for reply, none were returned, so someone has benefited.

At first I did not enclose stamps and stated my age, latterly I enclosed stamps but did not state age. The experience quoted showed that I had at least thirty years' service, and even if they could not return stamps the guess that I was over fifty was an easy one.

I then started on my own, and am doing not so badly, and by the time I am eighty I hope to be again on top.

I don't deserve sympathy and won't get it. I am well and can run up stairs two at a time and don't mind buses. Only complaint, not enough to do.

What is wrong with British methods. Read this. I have kept tab of letters written and replies, and this is the result. Allowing for possible loss in post the following countries answer all letters: U.S.A., India, South Africa, Germany, France and Sweden. South America and Egypt answer none; Australia answers 83 per cent.; and England, my England, 32 per cent.

All letters are to the same trades, and with the exception of Germany, Sweden and France, all are to British-owned businesses; 2376 letters are included in the calculations.

London, July 8th. A CLIMBER.

SIR,—May I add my quota of sympathy with "John of Aylestone" and others similary situated.

Like "John of Aylestone," I have written well over three hundred applications and inquiries meeting with no success, and even the offer of my services at the same salary as a younger man was equally unsuccessful.

Youth and cheapness is evidently preferred to experience and its value.

If a man is too old at forty-five to fifty to be employed, then the sooner all men of that age and over are dismissed their positions and replaced by the younger men so eagerly sought after, the sooner we shall see where our businesses stand and for how long!

London, July 8th. ANOTHER SUFFERER.

CENSUSES AND STATISTICS.

SIR,—May I urge forward a discussion of the merits of a habit which we all seem to be falling into of making a census, or compiling statistics, concerning some individual subject? You, yourself, objected to the scheme adopted by our Government in connection with the export of agricultural machinery, and I have just noticed that one of the leading engineering journals has much the same complaint—that is to say, the information given by the statistician may be complete in itself and is, presumably, accurate; but, on account of changes in the system of tabulation or other variants, it is seldom possible to make true comparisons measured in standard units. And presumably that is the justification for the vast mass of statistics now collected and stored. For they are stored, and many are seldom consulted after they have been tabulated.

In some cases, of course, continuity of records is established, but my experience leads to the belief that in such cases the details of the information provided and probably even the major items are ignored by those for whose benefit they are ostensibly prepared. So long as the job goes on and continues to provide a living for its dependents that is sufficient. And some of those dependents are probably writing down figures unwillingly, while they might be doing something more productive.

Would it not be better for our advancement if greater encouragement were given to men who could "coast around" and say that any process was being carried out on a good, bad, or indifferent procedure and to give some indication, immediately, of the means of improvement?

Notts., July 9th. SWITCHBOARD.

EARLY RAILWAY GAUGES IN THE U.S.A.

SIR,—May I correct an error—my own—in the footnote to "The Story of the Baltimore and Ohio Railroad," on page 17 of your issue of July 5th?

The *total* mileage in the U.S.A. in 1873 was about 66,490. Of this, 43,676 were 4ft. 8½in. gauge, about 21,560 were of gauges from 4ft. 9in. to 6ft., definitely recorded. The balance consisted of various gauges from 3ft. to 5ft. 6in. J. G. H. W.

Bath, July 9th.

The Hardness and Abrasion Testing of Metals.*

By G. A. HANKINS, D.Sc., Associate Member.

Introduction.—This synopsis has been prepared by the author in accordance with a request of the Hardness Tests Research Committee of the Institution that a summary should be prepared of all the work done on the subject since the publication of the Bibliographies as Appendixes to the Committee's Report of 1916,[1] together with a considered opinion of the present state of knowledge on the subject, and the directions in which further research is desirable. Since over two hundred papers or articles on hardness tests have been published since 1916, it will be understood that a lengthy treatise would be required to do full justice to the work which has been done. In order to keep the synopsis within reasonable limits, the subject matter has necessarily been treated in a very brief manner, and attention has been given to the practical aspects in preference to speculative questions. In accordance with the activities of the Committee, indentation hardness tests, abrasion or wear tests, and scratch hardness tests have all been considered.

Indentation tests may be defined as those tests in which the surface of the material under examination is permanently deformed by the pressure of another body, the deformation being local in character and independent of the size of the piece of material under test. Abrasion or wear tests are those tests in which particles of the test material are actually removed from the surface by contact with some other material.

It is apparent from these definitions that the natures of the tests are essentially different, and in the present paper they have been considered separately. The scratch hardness test is often classified with abrasion tests, but in the view of the author, it occupies an intermediate position, and may be either an indentation test, or a form of abrasion test, depending on the actual method used in making the scratch. The body of the synopsis is arranged, therefore, in three main divisions: indentation tests; abrasion or wear tests; and scratch tests. It has been found inconvenient to depart entirely from the ordinary loose use of the word "hardness," but throughout the synopsis the term "Brinell number" has been restricted to the result obtained from the standard test recently laid down by the British Engineering Standards Association.[2] The expression of the result of an indentation test as a "hardness number," without a clear indication of the actual test which has been used, is quite indefensible now that so many methods are available.

Suggestions for Further Research.—The suggestions as to the directions in which further immediate research appears to be desirable are given in the body of the synopsis in conjunction with the subject matters with which they deal, but for convenience, the main suggestions in connection with indentation tests and scratch tests are given below. It is hardly possible to summarise the suggestions in regard to abrasion tests, but the position is discussed briefly later in this paper.

(1) It is suggested that the immediate problem which calls for attention in regard to indentation tests is not the development of new tests, but that a clearer and fuller understanding of the meaning of the tests already in everyday use should be obtained. The correlation of indentation tests with complete stress-strain curves is considered to be the most promising method by which to obtain a fuller insight into the meaning of the tests. In this connection, recent advances in the mathematical treatment of plastic deformation of ductile metals appear to be of value.

(2) An investigation of the limits of the distorted zone of material under a Brinell impression for representative materials would enable more exact test dimensions to be specified, and would lessen the risk of doubtful results being obtained.

(3) The provision of standard specimens which have been guaranteed on reliable authority to be of a particular Brinell number, would afford a cheap and easy method of checking the accuracy of machines in everyday use.

(4) It is suggested that experiments should be made with a view to the standardisation of a representative diamond indentation test.

(5) The Herbert pendulum "induced hardness" test

* The Institution of Mechanical Engineers. Hardness Tests Research Committee. Issued for written discussion, which closed on June 30th, 1929.

[1] "Proc." I. Mech. E., 1916, Vol. ii., page 677.

[2] The index figures refer to the items in the Bibliography, Appendix, pages 37–57.

appears to be of distinct value and worthy of study, since it gives some measure of the work-hardening properties of metals.

(6) It is concluded that recent applications of the diamond scratch test are particular forms of the indentation test; the older forms of the scratch test appear to have been types of abrasion tests, and it is suggested that an application of the diamond scratch, purposely arranged to produce sliding abrasion and not flow under pressure, might give results which could be translated into resistance to wear under particular conditions.

I.—Indentation Hardness Tests.

(*a*) *The Brinell Test.*—The static indentation test is probably the most valuable of the hardness tests in general use, and of the various forms of the test, the steel ball Brinell test is the most important. The simplicity of the test, and the ease and cheapness with which accurate hardened steel balls can be obtained, appear to be the main factors in its wide popularity. As a standard of reference on an arbitrary scale, for comparison of the uniformity or otherwise of commercial metals and alloys, and as an indication of the tensile strength of steels, the Brinell test now appears to be more extensively used than any other form of mechanical test.

For the period under review, one important advance can be noted in the practical application of the test. The arbitrary conditions of the original test, namely, a load of 3000 kilos. on a 10 mm. diameter steel ball, confined its application to relatively large pieces of material, but the experimental proof that the principle of geometrical similarity could be applied to ball indentations, has greatly widened the scope of the test. This principle may be stated in the following form. "With balls of different size, loads proportional to the squares of the ball diameters, produce geometrically similar indentations in uniform material, and give the same hardness number." (Definition by H. Moore.) Many investigators have been concerned in the experimental proof of this principle, the truth of which is now generally recognised, but special mention may be made of the work of H. Moore and of Batson, following on that of Meyer in 1908. Moore first published a description of the now well-known "Baby Brinell Machine" in 1921, and had apparently been using small ball tests for some years. Batson, in 1923, gave the results of an investigation in which balls varying from 5 mm. to 50·8 mm. diameter were used, and concluded from his experiments that the principle defined above was sufficiently reliable to be adopted in accurate testing practice. Attention may be drawn to the fact, pointed out by Professor Haigh,[3] that the principle of geometrical similarity in indentation tests is an application of one of the laws of mechanical similarity enunciated by Professor James Thomson in 1875.

The variation of ball number or contact pressure ($\frac{P}{\pi r^2}$, where P = load in kilos. and $d = 2r$ = diameter of indentation) has been further examined by a number of workers, but the original conclusions of Meyer have not been disputed to any appreciable extent. The relation $P = a d^n$, sometimes known as Meyer's law, where a and n are constants for a given material, appears to be the most satisfactory manner in which to connect changes in the impression with variations in load. Both a and n are known to vary with the test material and since their determination requires at least two tests at different loads, it is necessary to specify the load in order to obtain a single ball hardness numeral for a given material. For 10 mm. ball tests, the usual loads have been 3000 kilos. for steels and similar materials, and 500 kilos. for softer materials, but the use of the test on materials for which even the 500 kilos. load has proved excessive has necessitated the use of smaller loads. To meet all cases, the British Engineering Standards Association has standardised the loads and ball diameters given in Table I. The relative tests loads are conveniently expressed in the form of certain values of $\frac{P}{D^2}$ (D is the ball diameter in millimetres), and from the table, it can be seen that full recognition has been given to the principle of geometrical similarity mentioned above. For expressing results, Brinell's method, namely, load/spherical area of indentation, has been standardised, and the four standard values of $\frac{P}{D^2}$ allow the test to be used over an extremely wide range of materials varying from lead $\left(\frac{P}{D^2} = 1\right)$ up to steels $\left(\frac{P}{D^2} = 30\right)$, and on large or small test specimens. For general comparison of results, it is obviously important that the standards suggested should be used in all applications of the ball test.

Table I.—*Standard Balls and Loads for Brinell Hardness Tests.*

Diameter of ball.	Load.			
	$\frac{P}{D_2} = 1$	$\frac{P}{D_2} = 5$	$\frac{P}{D_2} = 10$	$\frac{P}{D_2} = 30$
mm.	kg.	kg.	kg.	kg.
1	1	5	10	30
2	4	20	40	120
5	25	125	250	750
10	100	500	1000	3000

The scale is not ideal, but it certainly appears to be the best that can be obtained by the use of a ball and standard loads over particular ranges of hardness. A way in which to obtain a more rational scale would be to measure the load required to produce a standard indentation, say $\frac{\text{diameter of indentation } (2r)}{\text{diameter of ball}} = 0{\cdot}5$, and express the result in the form $\frac{P}{\pi r^2}$, but as a practical test this would obviously be far less convenient than the methods specified. The use of a conical or pyramidal indenter would amount to the same thing as a standard ball indentation, and any convenient load could be used, but in this case the advantage of having a cheap standard indenter which can be easily renewed, namely, a hardened steel ball, would be lost.

For the specified standards, slight difficulties may arise in the cases of borderline materials between two values of $\frac{P}{D^2}$. Thus the use of $\frac{P}{D^2} = 10$ for copper alloys, and $\frac{P}{D^2} = 5$ for copper, may be quoted as an example. Considering 10 mm. ball tests, the specified loads are 1000 kilos. and 500 kilos. respectively, and since in these materials, the value of load/spherical area of indentation usually increases with values of the load up to 1000 kilos., direct comparison of standard results would tend to give slightly higher values to the copper alloy than would be obtained in a direct comparison at the same testing load. In order to avoid slight confusion in cases of this type, it may be advisable to use the two relevant values of $\frac{P}{D^2}$ when results of tests on borderline materials are being published. In using small balls (and also with diamond indenters) it is desirable that the grain size of the material should be small in comparison with the size of the indentation.

Considerable discussion has arisen as to the best method of measuring the indentation produced in the Brinell test. Owing to the ridge produced around the impression, the spherical area obtained from a depth measurement is not the same as that obtained from a diameter measurement. The difference arises in that the depth measurement is obtained from the depth of the lowest point of the impression below the original surface of the material, and the ridge effect is thus neglected, whereas the diameter measurement includes the ridge. The question is also complicated by the experimental proof that the radius of the impression is usually greater than that of the indenting ball. Devries in 1911 [4] pointed out that when the depth of the 10 mm. ball indentation was used for calculating hardness numbers, the figures then obtained were approximately independent of the load, but the depth measurement method appears to have received little support in this country. The matter is of importance, however, in regard to the commercial use of the ball test. It is comparatively easy to devise a method in which the depth of an indentation is recorded on a dial, as, for example, in the Rockwell machine, or by the movement of a column of liquid, as in Marten's machine, but the diameter measurement normally involves the use of a measuring microscope. Any modification of the ball test which eliminated the misroscope is advantageous from the practical point of view, but unfotunately depth measurement results are considerably different from diameter measurement results. The inner side of the ridge helps to support the applied load, and this is in favour of the diameter measurement. Further, although there is no direct evidence, it appears that the diameter of an indentation is not appreciably affected by the removal of the load. A depth measurement which is made after the load has been removed, either wholly or in part, is appreciably affected by elastic recovery of the material and probably by "after elastic working" or creep, in addition to the error caused by neglecting the ridge. Accordingly, if the Brinell number be regarded as a mean pressure over the indentation under the test conditions, the diameter appears to be the most representative measure from which to obtain the result. Owing to variations in ridge formation and elastic recovery in different metals, no universal conversion formula can be used for converting depth measurement results to diameter measurement results, and theoretical formulæ based on the geometry of the impression are only approximately true. In using a formula of this type, as for example, in converting Rockwell numbers to Brinell numbers, the constants in the formula should be determined from actual experimental results. The diameter measurement is now standardised in this country, but a simple accurate practicable method of obtaining the diameter of an impression without the use of a micrscope would be valuable in the commercial appliion of the Brinell test.

The experience of the author has shown that many users of the Brinell test are somewhat careless in applying it to specimens which are too small or too thin for correct results to be obtained. Certain dimensions of the specimens are given by the British Engineering Standards Association, and it should be understood that test-pieces of smaller dimensions are liable to give low results. In general, however, the exact limits of the distorted zone of material under the ball do not appear to have been determined, and it is suggested that an investigation of these limits for a number of representative materials would be of value, and would enable more exact dimensions of test specimens to be specified.

It is not proposed to give details of the various machines which are now available for carrying out Brinell tests, but it is obvious that the weights and lever distances should be accurate, and that overloading due to inertia effects should be avoided. Petrenko, of the Bureau of Standards, has given details of an accurate method of calibrating Brinell machines, and has considered in detail the errors which may arise in the test. A series of fourteen recommendations as to the procedure advisable in making a Brinell test have been published under the authority of the Bureau of Standards, and although one or two of the recommendations are very obvious, they form a useful guide to users of the test. Somewhat similar, but less detailed, recommendations have also been given by the British Engineering Standards Association. There appears to be no easy method available at present in this country, whereby the accuracy of Brinell machines can be checked. Actual calibration and correction of the loads in a given machine is the best method, but the provision of standard specimens which have been guaranteed on reliable authority to be a particular Brinell number, would afford a cheap and easy method of checking the accuracy of machines in everyday use.

The effect of time of loading on the result of a Brinell test has been examined by several workers, and in general it appears to be unnecessary to maintain the load for more than 15 seconds for normal work on steels. Milander has carried out accurate tests on the time effect, and has found that equilibrium is reached after one minute on hard steel. For soft iron equilibrium was not attained after five minutes loading. He concludes that the error in both hard and soft steels for 10 seconds loading is less than 3 per cent. For tests on non-ferrous metals and for high-temperature tests, the time effect may be considerable, and since it will vary with the material and with the temperature, it is necessary to state the time of loading in recording results of such tests.

Mention has already been made of Meyer's law $P = a d^n$ for ball tests, and it has been known for some years that the value of n can be used as an indication of the state of the material with reference to cold work. Thus Kurth[5] found that n had the value 2·50 for annealed copper, and 2·01 for cold-worked copper. Further careful experiments on this point have been made by Baker and Russell, and their results show that n (10 mm. ball) decreases from 2·293 for annealed mild steel, to 2·095 for the same material cold-worked by tensile straining. The constants a and n have also been discussed at length by other workers. It has been suggested that a and n can be regarded as fundamental constants of the hardness of a material, but from dimensional considerations of the formula, d^n appears to be some unknown function of d^2. Since any rational conception of resistance to indentation must have the dimensions of a stress, it is necessary to determine the function of d^2 which can be represented by d^n before fundamental ideas can be obtained from Meyer's law. As an indication of previous cold work on the material, however, the value of n is undoubtedly useful. As a rough approximation for works use, it is hardly necessary to determine the value of n by logarithmic plotting, but the ratio of the contact pressure or ball number $\left(\frac{P}{\pi r^2}\right)$ at 3000 kilos. to that at 500 kilos. can be taken. Thus, in Baker and Russell's tests this ratio is 1·25 for annealed mild steel and 1·09 for the same material in a highly cold-worked condition. The change in the ratio would, of course, depend on the nature of the material under test, and the figures quoted are merely given as an example.

The Ratio of Tensile Strength to the Brinell Number.—It has been known for many years that a more or less constant ratio exists between the tensile strengths of steels and their Brinell numbers, but since the Brinell test is empirical, the ratio is based entirely on experimental results, and the values for different steels should be obtained by statistical methods. Using such methods Greaves and Jones have examined the value of the ratio for over 1000 steel specimens which have been tested in the Research Department, Woolwich, and the conditions under which the tests were made suggest that the results can be used with confidence. The values they recommend are:—

Ratio $\frac{\text{Tensile strength, tons per sq. in.}}{\text{Brinell number}}$	
(1) For heat-treated alloy steels with a Brinell number of 250–400	0·21
(2) For heat-treated carbon steels and for alloy steels with a Brinell number below 250	0·215
(3) For medium carbon steels, as rolled, normalised or annealed	0·22
(4) For mild steels (based on results of other workers), rolled, normalised or annealed	0·23

These ratios do not apply to severely cold-drawn or to Austenitic steels.

As far as the author is aware, no conclusive evidence has been advanced in explanation of the constancy of the tensile strength/Brinell number ratio.

Baumann and Bohner have given experimental evidence that an approximate indication of the tensile strength of aluminium alloys can be obtained from Brinell tests, but apparently considerable care is required in carrying out the tests and the application of the conversion relationship is limited. In the opinion of the author there is scope for development in this work.

Portevin and Schuz have suggested that the tensile strength of cast iron can be estimated from the Brinell number of the material, but a report issued by the British Cast Iron Research Association does not agree with their suggestions. The latter states that the Brinell number of cast iron is governed broadly by the phosphorus eutectic, whereas the tensile strength is governed, in the main, by the size and distribution of the graphite, and hence an invariable relation can scarcely be expected.

(To be continued.)

INTERNATIONAL CONGRESS OF MINES, METALLURGY AND APPLIED GEOLOGY.

The sixth session of the International Congress of Mines, Metallurgy and Applied Geology is to be held at Liége in 1930. It will be under the patronage of King Albert and the Belgian Government. It was decided during the course of the last Session of the Congress, which was held in Düsseldorf in 1910, to entrust the organisation of the sixth session to the following bodies:—

The Imperial College of Science and Technology London;
The Geological Society of London;
The Institution of Mechanical Engineers;
The Iron and Steel Institute;
The Society of Chemical Industry;
The Institution of Mining Engineers;
The Institution of Mining and Metallurgy;
The Institute of Metals.

In view, however, of the fact that the Liége International Exhibition is to take place in 1930, the necessary arrangements for the next Congress have, at the request of those bodies, been taken over by l'Association des Ingénieurs sortis de l'Ecole de Liége and la Société Géologique de Belgique à Liége.

The Congress, which will include plenary and sectional meetings, visits to works, receptions and various other functions, will be held at the end of June, 1930, and will continue for about a week. General Mechanics will be the subject of a special Congress.

Further particulars may be obtained on application to Monsieur O. Lepersonne, Secrétaire-Général de l'A.I.Lg., 16, Quai des Etats Unis, Liége, Belgium.

The Amalgamated Wireless Company proposes, according to the *Daily Telegraph*, to install a modern wireless station at Port Moresby, Papua, for communication direct with Sydney and also with ships. This will avoid the delays that have occurred in the past through relays having to be made by land lines.

[3] "Proc." I. Mech. E., 1923, Vol. i., page 470.

[4] Technological Papers, Bureau of Standards, U.S.A., No. 11.

[5] *Z.V.D.I.*, 1908, Vol. 52, page 873.

The Royal Agricultural Show at Harrogate.

No. II.*

THE Show, which commenced on Tuesday last, is being held on the Stray at Harrogate, and probably no more suitable site could be chosen. The Show ground is beautifully situated, extremely level, and is surrounded by excellent roads. The showyard is unusually compact, and is divided transversely by a public road. One half is devoted entirely to live stock and show rings, while the other half is taken up by the implement section, the total showyard area being about eighty-three acres. That is a much smaller space than usual, but visitors to the implement section are having less difficulty than is frequently the case in finding the individual exhibits. The machinery in motion section is particularly compact, and although there are some important absentees, the exhibits compare favourably with those of other years.

WALLIS AND STEEVENS.

This firm's exhibits include the "Advance" steam roller with quick reversing motion and rear axle with automatic cambering device, which is already familiar to our readers, and a new 3-ton steam roller—Figs. 8 and 9. The keynote of the design of this roller is simplicity. The chief dimensions of this machine are: Rolling width, 5ft.; wheel base, 7ft. 1in.; outer turning radius, 12ft.; rear rollers, 3ft. 9in. diameter by 1ft. 6in. wide; front roll, 3ft. diameter by 2ft. 8in.

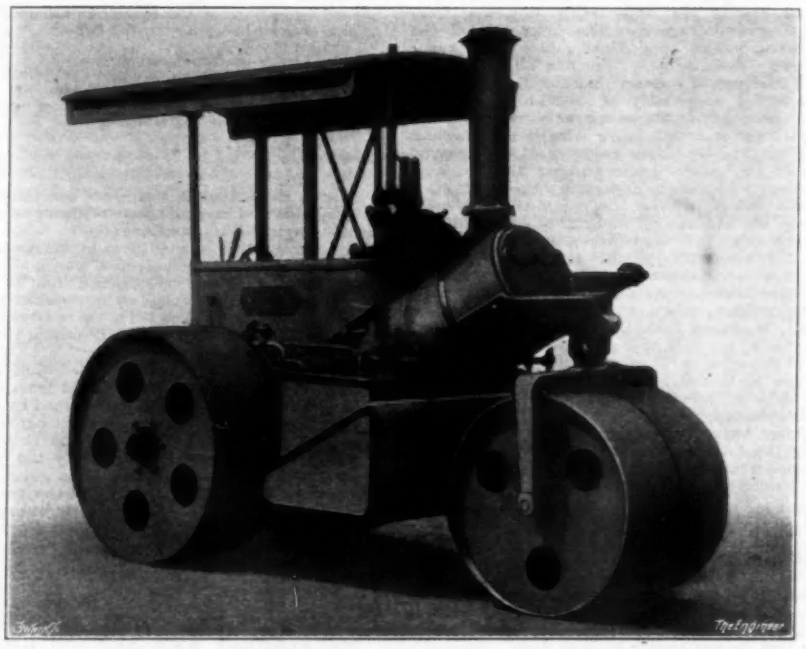


FIG. 8—"SIMPLICITY" 3-TON STEAM ROLLER—WALLIS AND STEEVENS

wide; working pressure, 130 lb.; and bore and stroke of the cylinder, 4in. by 6in. It will be observed from the sectional drawing of the boiler, which is patented and is of new design, that it consists of a plain cylindrical shell with a cylindrical fire-box, so that there is an absence of internal projections and corners or of fire-box stays to accumulate deposits or to interfere with thorough cleansing, which latter is much facilitated, as any mud tends to fall to the mud doors situated at the lower end. It will be noted that both tube plates are inclined so that the tubes at their front end are, under all normal conditions, fully covered, and even on very stiff gradients, unless the water level is abnormally low, if temporarily uncovered, are still protected by splash; exceptional protection is given to the fire-box crown and there is a steam space under the cylinder foot. It will be recognised that renewal of the fire-box at any time is a simple and inexpensive operation. The furnace front is in one casting held in position by bolts, and is, hence, easily renewed. The fire door permits of easy stoking and cleaning and the fire-bar mounting provides a long fire-grate. The front roller saddle being attached underneath, instead of on the top of the smoke-box, gives easy access at the front end for sweeping the tubes. The oblique mounting of the boiler enables the crank saddle box, shafts and gears to be kept at a much lower level than with the ordinary locomotive type. The engine, which is of the single-cylinder open type, is mounted on the boiler at the highest point so as to secure dry steam. It is cast in one piece and is fully steam jacketed. The slide valve is of the link pattern and the Stephenson link reversing motion is accessible. The crosshead guide is of the trunk pattern. The transmission is by spur gears of forged steel and machine cut. It provides one speed with throwing-out gear for free running. At an engine speed of 300 r.p.m. the road speed is about 1½ mile per hour, but that rate can, of course, be increased considerably. A three-pinion type of differential gear is fitted on the intermediate shaft to equalise the drive of the rolls and to enable sharp curves to be taken easily. The attachment of the fore carriage to the boiler is clearly shown in the general view of the roller. The saddle casting is attached to the front end in a simple manner. Steerage is by a worm and quadrant and a screw-operated friction brake with renewable blocks is provided.

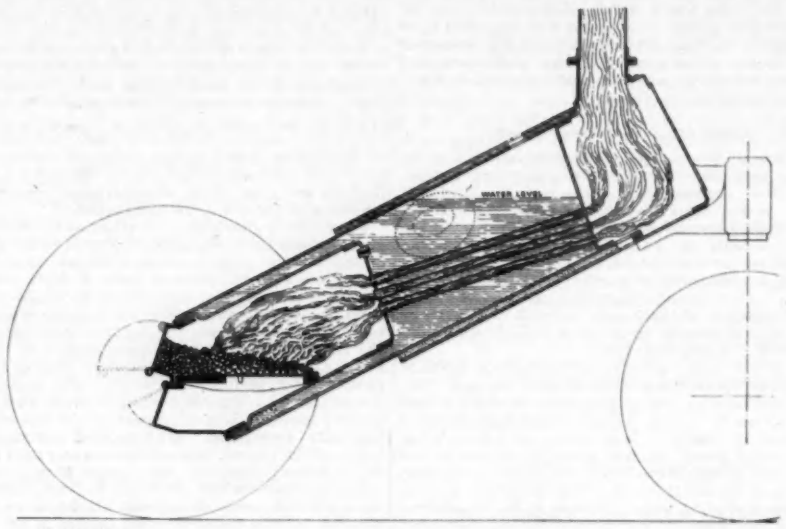


FIG. 9—SECTION THROUGH BOILER OF "SIMPLICITY" ROAD ROLLER—WALLIS AND STEEVENS

LATIL INDUSTRIAL VEHICLES.

French engineers have always been to the fore in motor vehicle design and construction, and this remark is particularly applicable to the exhibits of Latil Industrial Vehicles, Ltd., which is the concessionnaire for Automobiles Industriels "Latil," of Suresnes. One of the series of vehicles exhibited by this company is shown in Fig. 10. It is a four-wheel driven tractor which is specially designed for soft ground and colonial work. The power unit is a four-cylinder petrol engine with bore and stroke of 85 mm. by 130 mm., which is rated at 17·9 horse-power at 1750 revolutions per minute. The gear-box, transmission and gripping devices applied to the road wheels are the special features of this remarkable machine. The clutch, which is of the single dry plate type, is contained within the fly-wheel, and is particularly light in operation. The gear-box is bolted to the rear of the engine crank case, thus forming a unit which is supported in the frame at three points, centrally at the front end in a spherical rubber-lined mounting, and at the rear on side brackets provided with rubber pads. The fixing bolts are fitted with springs, so as to reduce vibration to a minimum. The box is divided into two compartments, the forward of which contains three forward and one reverse sets of gears operated by a single ball gate lever centrally placed on the gear-box cover. The rear portion contains a high and low ratio set of gears operated by a second lever, also mounted on the gear-box cover, thus giving a range of six speeds forward and two reverse. The drive is transmitted to the main shaft, which carries the transmission brake drum, and a universal cardan coupling at the front and rear ends. By moving the second lever into a third position, power is conveyed to an auxiliary shaft for the operation of a capstan, pulley or other mechanism, with a range of four speeds obtained by the operation of the first lever. The lubrication of the gear-box is maintained by a pump delivering oil to a trough in which rotates a worm throwing the oil over the moving parts.

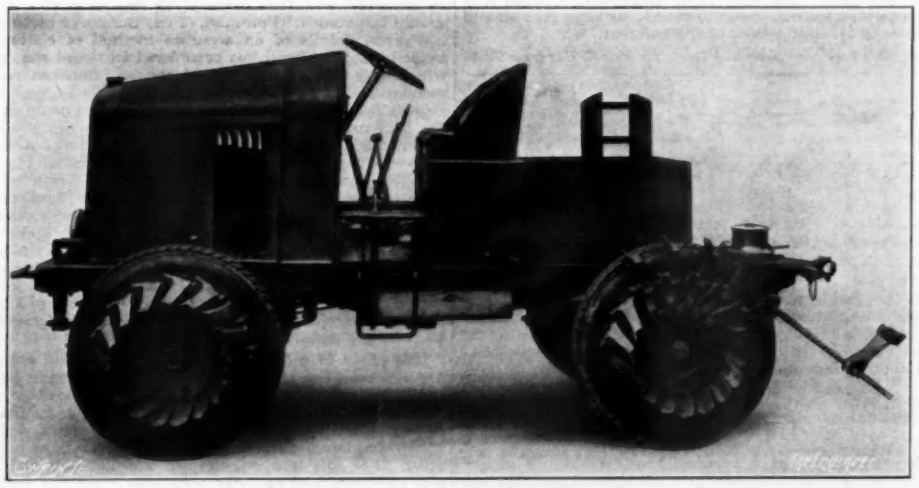


FIG. 10—FOUR-WHEEL-DRIVE TRACTOR—LATIL

* No. I. appeared July 5th.

From the main gear shaft, cardan shafts are carried fore and aft, to differentials mounted in cases which are bolted to the chassis cross members. From the differentials, universally-mounted driving shafts transmit the drive to all four wheels through internal toothed gears forming the final reduction. These gears are enclosed in oil-tight casings. Both differentials can be locked simultaneously by a control lever from the driving seat.

The road wheels shown are of the disc type, shod with pneumatic tires and provided with folding adhesion blades to work in conjunction with the pneumatic equipment for mixed service.

KARRIER MOTORS, LTD.

In the commercial motor vehicle section Karrier Motors, Ltd., of Huddersfield, is exhibiting three

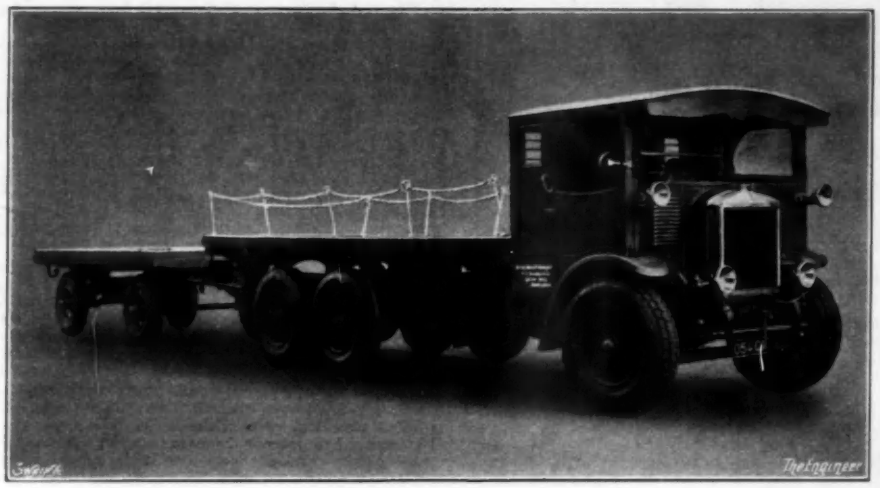


FIG. 11—SIX-WHEEL 8-TON LORRY AND 4-TON TRAILER—KARRIER

of its standard models, two four-wheelers and one six wheeler—Fig. 11. The last-mentioned machine is capable of carrying a load of 8 tons and hauling a 4-ton trailer when required. The engine is a four-cylinder mono-bloc unit with detachable head, with bore and stroke of 5in. by 6in., and it develops 60 horse-power at 1000 revolutions per minute. The clutch is of the cone type, totally enclosed and leather lined, and the gear-box provides four forward speeds and a reverse. The final drive is taken from the gear-box to a forward driving axle by a propeller shaft, fitted with two automatically-lubricated star-type universal joints, and a splined plunger joint protected by a sliding muff. The design incorporates twin axles of bogie construction. They are of the overhead worm-driven type, the gearing of each axle being mounted on a self-contained unit removable from the main casing. Oil fillers are so placed that the axles cannot be overfilled. The wheels are mounted on taper roller bearings. A cardan shaft, fitted with universal joints at either end, connects the rear end of the forward worm shaft to the front end of the rear worm shaft. The driving and braking torque of the axles is taken direct to the frame by means of universally-jointed torque rods which connect each axle casing to a tubular cross member of the chassis.

The rear bogie is fitted with two pairs of semi-elliptic springs of silico-manganese steel. They are long, wide, and resilient, have positive endwise location, and each pair is free to swivel on a central fulcrum bracket attached to the frame. The frame is of pressed steel of very deep section, and the height of the frame from the ground—loaded—is 2ft. 8¾in. The side members are outswept to a width of 4ft. 3in., and each member encircles the axles at these points, being pressed out in banjo form to allow for axle movement and also for withdrawal when necessary. Cross members at suitable intervals form a structure of great strength and rigidity.

The lubrication of the engine is elaborate. A positively-driven gear pump ensures a copious supply of oil at the necessary pressure to maintain a constant lubrication of all bearings and wearing surfaces throughout the engine. The main bearings, timing wheels and chain are pressure fed, whilst lubrication of the big-ends, gudgeon pins, and cylinder walls is maintained by oil splashed up by means of connecting-rod dippers from troughs in which the oil level is constant. The oil is drawn from the sump by pump, from which it passes under pressure through a large oil filter at the front of engine to bearings and troughs, and it returns through a fine mesh filter to the sump, where it is cooled and drawn off again for recirculation.

SENTINEL WAGGON WORKS.

This Shrewsbury firm sticks firmly to steam as the motive power for its wagons, as is demonstrated by the three machines which are on view at Harrogate. Two are rigid six-wheelers—Fig. 12—with load capacities of 12 to 15 tons, and one is a four-wheeler for carrying the same load. The two-speed engine has cylinders 6in. bore by 8in. stroke, and is horizontally disposed. The boiler pressure is 275 lb. per square inch, and the unladen weight with flat platform is 8 tons. The average fuel consumption

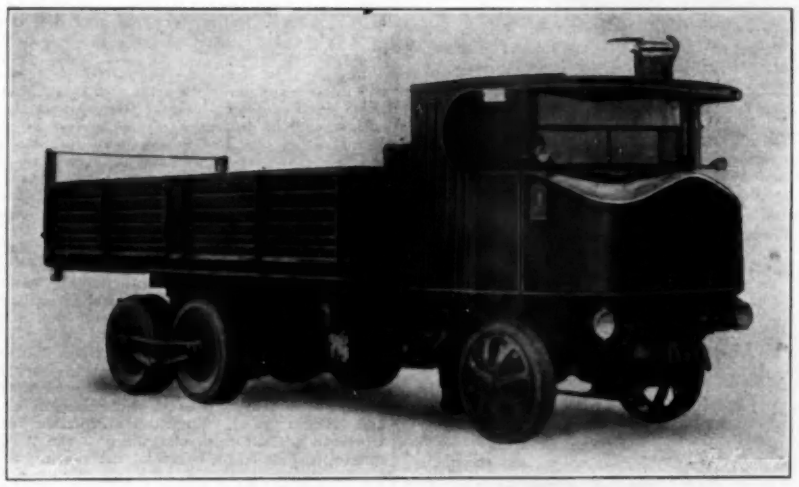


FIG. 12—STEAM TIPPING WAGON—SENTINEL

with a 15-ton load is given as being 17 miles per cwt., and the approximate engine speed in top gear at 12 miles per hour is 390 revolutions per minute, while in bottom gear at 6 miles per hour the revolutions are 595 per minute. The design of the Sentinel engine is familiar to readers of THE ENGINEER. The boiler is of the water-tube pattern fitted with a combined blast nozzle and blower ring. This allows of the blower being used to supplement the blast without danger of damaging the fire, whilst it removes the trouble experienced with the older blower pipe of burning away when the fire was fierce. The rear wheel suspension of the rigid six-wheeler is of special design. The rear bogie consists essentially of four very strong, cast steel arms, pivoted at their centres upon the end of a hollow steel axle 9in. in external diameter. Upon this latter are mounted two strong steel spring pads, which carry double or compound springs by which the weight of the chassis above is supported. The four free ends of the arms are connected together by strong stub shafts, which form the axles upon which the wheels run on long, anti-friction bearings. The main axle is guided in an arc of a circle by means of radius rods which are connected, not directly to it, but to the forward end of the arms which carry the wheels. The effect of this arrangement is to permit of a chain drive, since the radius rods maintain the distance between the forward ends of the arms and the lay shaft centre, unalterable, whilst the arms themselves maintain the proper chain drive distance between the forward and rearward pairs of wheels.

The transmission on the "Sentinel" rigid six-wheeler is similar to that which has been employed on all "Sentinel" vehicles for the last twenty-five years. The builders make use of the silent roller chain. On each end of the lay shaft in the gear-box there are fitted two large chain pinions, with nineteen teeth. On these run two silent roller chains—2in. pitch—which drive direct on to chain wheels bolted to the forward pair of rear wheels. The correct chain tension is maintained by means of stout radius rods, which are fastened to the engine suspension bracket immediately underneath the lay shaft and to the forward ends of the rear bogie arms. From the front chain wheels a second pair of chains transmit the drive to chain wheels on the rearmost wheels.

MARSHALL, SONS AND CO., LTD.

The exhibits of the Gainsborough firm of Marshall, Sons and Co., Ltd., cover a very wide range of products, including thrashing machines, traction engines, steam rollers, oil engines—both of the two and four-stroke varieties—concrete mixers, an oil-driven road roller, and an entirely new pattern of motor roller. Being the most novel, we shall deal with the last-named exhibit first. It is the result of many years of experimental work in endeavouring to produce a light-weight self-propelled roller in simple and cheap form. The roller is illustrated in Fig. 13. The shell is made of mild steel and the ends are of cast iron, machined and bolted in position, the engine, reduction gearing and driving mechanism being all mounted on

FIG. 13—"MANUNIT" MOTOR ROLLER—MARSHALL

a heavy cast iron base plate suspended from the axle. The roller is made in two sizes, *i.e.*, 12 cwt. with a 1½ horse-power two-stroke petrol engine, and 1 ton with a 3½ horse-power two-stroke engine. Petroil lubrication is employed. Power is transmitted through a flexible coupling to a worm reduction gear, in which ball bearings are used throughout. The reduced speed shaft is supported by a self-aligning ball bearing. Mounted on this shaft is a plain friction wheel, through which power is transmitted to the track of the roller by loose friction rollers carried by a rocker arm keyed to the axle. The roller handle is also keyed to the axle. When the handle is in the vertical position the loose friction rollers are out of engagement with the track. As the handle is depressed the rollers are brought into contact with the driven friction wheel and the track of the roller, so as to propel the roller in a direction away from the operator. No chains or gears are employed in the transmission and there is only one lever to operate, *i.e.*, the carburetter control, which is fitted to the handle in a convenient position and by which the speed of the roller can be varied from ½ to 3 m.p.h. A brake is provided whereby the roller is automatically brought to a standstill when the handle is in the vertical position. In addition, the engine itself can be used as a brake when travelling, by closing the throttle and pressing down the handle.

The engine starter is of a very simple kind. It consists of a small grooved pulley keyed to the driving shaft, and round this pulley is wound a cord which, when rapidly unwound, starts the engine. The makers claim that this roller is as useful for breaking down rough ground as it is for lighter purposes.

The 30 B.H.P. four-cycle horizontal engine which is shown in Fig. 14 has been designed on the Diesel principle, and the engine can be started "from cold" without the use of either lamp or electrical ignition. The method of injecting the fuel into the

engine cylinder obviates the use of a high-pressure air compressor, blast air bottle, or complicated valve gear. These single-cylinder engines are built in

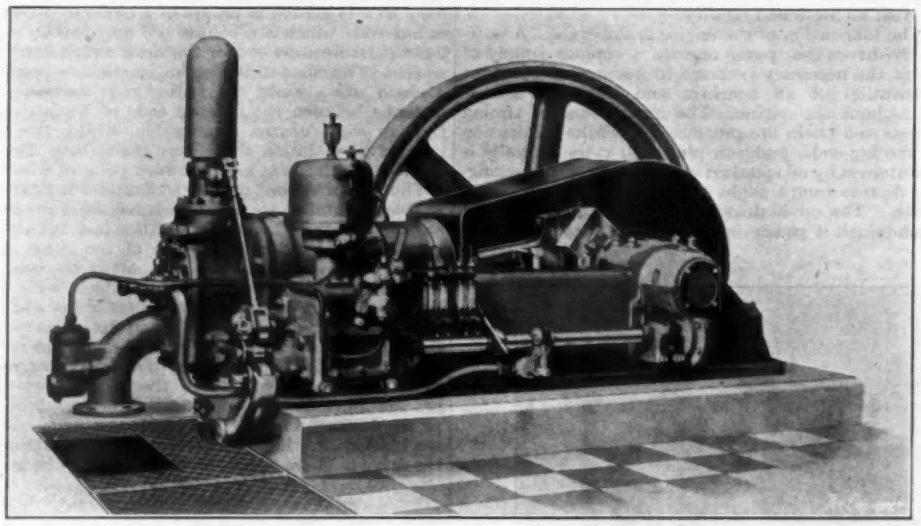


FIG. 14—30 B.H.P. HORIZONTAL OIL ENGINE—MARSHALL

various sizes from 15 to 50 B.H.P. and the fuel consumption is very low. The cylinder head is of simple construction specially designed to prevent unequal

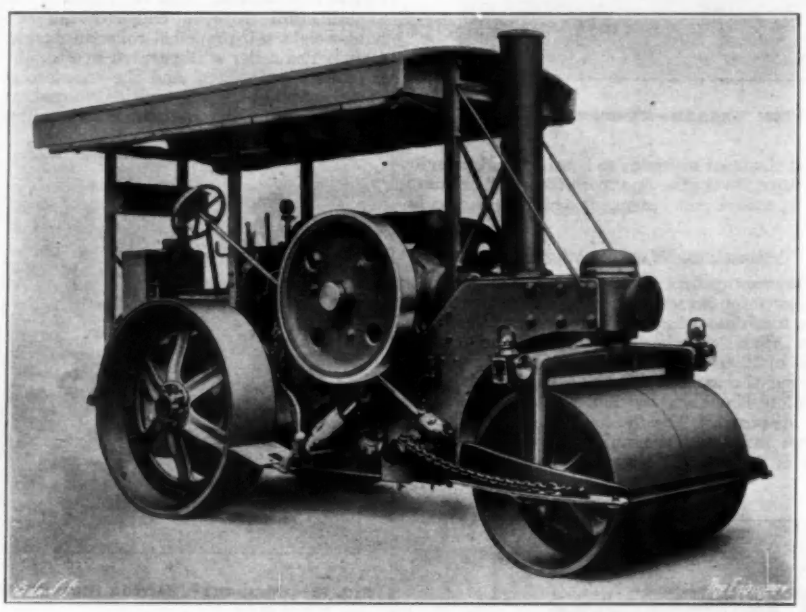


FIG. 15—OIL-ENGINE-DRIVEN ROAD ROLLER

expansion and possibility of cracking, and there is ample provision for cleaning the water spaces. The inlet valve is contained in a separate cage bolted to the cylinder head and easily removable, and both inlet and exhaust valves are operated by a simple one-cam gear. Marshall's oil-driven road roller, an illustration of which is given in Fig. 15, is propelled by a valveless two-stroke engine. The transmission is arranged on the five-shaft principle. Three speeds are obtainable, viz., 3, 1·6 and 1·1 m.p.h. Power is transmitted by powerful clutch drums with "Ferodo" contacts, and the drums are carried on a square section of the first intershaft. All the shafts are of specially selected steel, the driving axle being oil hardened. All the wheels have machine-cut teeth, except in the final drive. A four-pinion differential gear is fitted on the hind axle. The rolls are on the "three-wheel" arrangement. Each roll has its hub and spokes combined in a steel casting with renewable rims of cast iron.

HARRISON, MCGREGOR AND CO.

A feature of novelty which will appeal forcibly to farmers is to be found on the stand of Harrison, McGregor and Co. It is a 7ft. steel binder driven direct by a Ruston tractor, as shown in Fig. 16.

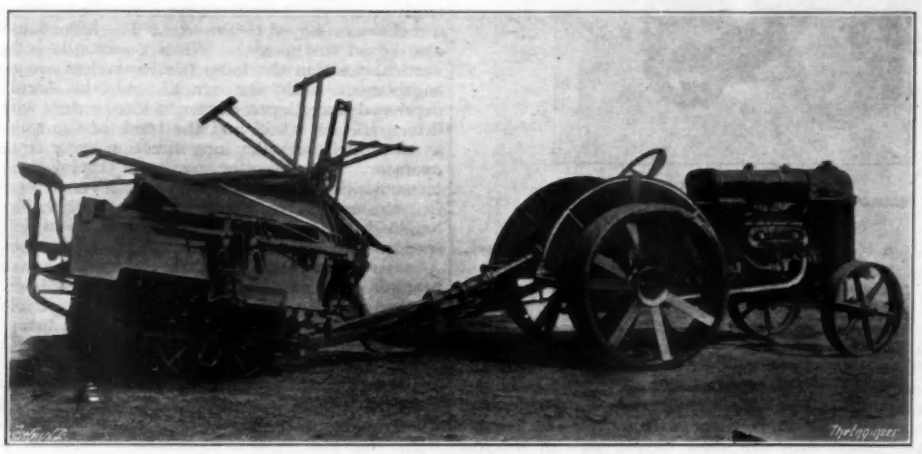


FIG. 16—SELF-BINDER AND TRACTOR—HARRISON, MCGREGOR, AND RUSTON

By this arrangement the entire mechanism of the binder is driven from the tractor by means of the diagonal shaft and friction clutch shown. Such an arrangement gives uniform speeds of cutting and binding independent of the travelling speed of the tractor, while, owing to the fact that the binder wheel supports and does not drive the machine, as is usual, slipping of the travelling wheels on soft ground is eliminated. A feature of importance to which attention should also be called is an arrangement of an adjustable spring whereby the pressure on the faces of a driving clutch can be controlled as required to enable slipping to take place in the event of stones or other obstacles getting into the cutting knife.

(To be continued.)

The Advisory Committee on Steam Turbines.

MEETINGS of the Advisory Committee on Steam Turbines of the International Electrotechnical Commission have been held during the past week at the Institution of Civil Engineers. The secretariat for this Committee is the United States National Committee. The technical discussions are a continuation of the discussions which have taken place in New York, Bellagio (Italy), and The Hague in 1926, 1927 and 1928 respectively, and centre round two main documents, namely, the International Specification for Steam Turbines and International Rules for Acceptance Tests for Steam Turbines respectively.

The first of these documents is the shorter of the two, and the discussions thereon have practically reached finality. This specification deals with the performance of the turbine, but does not restrict the designer in any way so far as mechanical construction is concerned. Two important appendices are attached to the specification, namely:—(*a*) Information to be supplied with inquiry or order for steam turbines; and (*b*) recommended standard ratings and steam pressures for steam turbines.

The second document, the Rules for Acceptance Tests, is intended to prevent disputes between the manufacturer and purchaser in connection with the conduct or results of an acceptance test. The rules lay down that the purpose of acceptance tests is to verify guarantees given by the manufacturer, and that only such tests, observations and measurements should be made as are necessary for this purpose. The rules contain sections dealing with the following subjects:—Enumeration and description of terms; guiding principles; instruments and methods of measurements; notes on computation of results; enumeration of data and results. The last named section is based on the Report of the Heat, Engine and Boiler Trials Committee of the Institution of Civil Engineers, London, and the section on Methods of Measurements is largely based on the Test Code drawn up by the American Society of Mechanical Engineers.

The deliberations of the Advisory Committee have been very greatly facilitated by the excellent manner in which the United States Committee of the I.C.E. has, in its capacity as secretariat of the Advisory Committee, presented the material which has been tentatively agreed upon at previous meetings of the Advisory Committee.

With the exception of the section on Instruments and Methods of Measurements, substantial agreement has now been reached regarding the whole of the rules, and that portion of the rules dealing with the Instruments and Methods of Measurements has been referred to the National Committees for further consideration. The whole of the material will be reviewed, and it is hoped, finally agreed to at the Plenary Meeting of the I.E.C. to be held in Sweden in 1930.

The British National Committee, in association with the Steam Turbine Section of the B.E.A.M.A., acted as host to the foreign delegates throughout the week. It entertained the delegates to luncheon on the opening day, Monday, July 1st, and to dinner on July 4th, after which the delegates took part in the Conversazione at the Institution of Electrical Engineers. On Friday, July 5th, they were taken to Oxford, visiting several of the Colleges, returning by road and river to London in the evening.

At the banquet on Thursday evening, Mr. Charles P. Sparks, C.B.E., chairman of the British National Committee, in expressing the pleasure of the British Committee at having this meeting in London, called attention to the main object of the I.E.C.; and reminded them that Lord Balfour (then Mr. Balfour) in 1908 in his address said that it was for the I.E.C. so to arrange matters that the purchasers shall understand the producers without fear of confusion, and to so arrange matters that tenders for electrical machinery could be compared on a common basis. Professor Feldmann, the President of the I.E.C., and Dr. Durand, Emeritus Professor of Sandford University, California, chairman of the Advisory Committee, responded on behalf of the visiting delegates.

IN the *Gas Journal* for July 3rd, Mr. Walter T. Dunn points out that carbonisation plant, the aggregate value of which runs into millions of money, has been specially designed and installed at the gasworks throughout the country; and no less than 20 million tons of coal are annually required to meet the demands of the British gas industry. The coal-receiving section of these carbonising plants has, of course, been designed in relation to the construction of the trucks which bring the coal from the mines to the gasworks. The introduction of the large-capacity truck of 20 tons would present serious difficulties to the gas engineer, who, it must be remembered, is primarily responsible for the running of his works successfully under regulations imposed by statute of Parliament. It would involve extensive and expensive alterations to the existing gasworks coal-receiving appliances to provide for the accommodation of the larger wagons—indeed, in some cases re-design of the coal-receiving and elevation plant—and serious reconstruction work would have to be carried out.

Railway and Road Matters.

As five points have fallen in the cost of living another shilling per week must be taken off the wages of those railwaymen—now very few in number—who still receive the war bonus.

THE London and North-Eastern Railway closed, on June 29th, the branch from Stamford on the former Great Northern to Wansford on the former London and North-Western. Only two passenger trains ran in each direction daily.

THE published traffic returns of the four grouped companies report an increase on the Great Western of £204,000 for the half-year just ended, and of £163,000 on the London and North-Eastern. The London, Midland and Scottish and the Southern show decreases; the former one of £519,000 and the latter one of £178,000.

SPEAKING at the meeting on July 1st at Southampton of the National Union of Railwaymen, the President, Mr. J. Gore, said that he would draw attention to the necessity of the members giving strict effect to the instructions issued by the railway companies with regard to the performance of work in shunting yards and depôts. Whilst it was recognised that in their zeal to expedite the work men were liable to err on the side of risk, no excuse could be offered and the Union could not defend such actions.

THE utility of shock-absorbing buffers—first introduced on the Midland Railway, to reduce the possibilities of of telescoping, after the Hawes Junction disaster of December, 1910—has been rather frequently displayed in some recent accidents on the London, Midland and Scottish, *e.g.*, Dinwoodie, Ashchurch and Doe Hill. It is now announced that the London and North-Eastern, possibly as a result of the experience at Darlington, will fit them to all carriages that are not equipped with automatic vestibule couplings.

DURING the month of April last the steam-operated trains on the Southern Railway, exclusive of the continental Boat Express, were only, on an average, 1·12 minutes late on their arrival at destination, as compared with 1·30 minutes in April, 1928. The electrically-worked trains had an average of 0·53 minutes late; the same figure as in the comparative month. Of the steam trains, 71·83 per cent., and of the electrical, 79·40 per cent. were on time. Of the freight trains, 83·1 per cent. started at the booked time and 57·3 per cent. arrived punctually.

CONSIDERABLE confusion has arisen from the statement in the House of Commons on July 4th by Sir Oswald Mosley that if the scheme connected with the Liverpool-street electrification goes through it will involve orders of between £75,000,000 and £100,000,000, very largely given to the steel trade. When questioned later in the debate, Mr. J. H. Thomas stuck to the figure, but there can be no doubt that £7,500,000 to £10,000,000 was intended. The Southern electrification is estimated to have cost £11,500,000 and that amount includes labour.

AT a meeting at the Ministry of Transport on July 4th between the Minister and representatives of the London County Council and of the London Electric Railway Companies, it was intimated that the Government could not advise Parliament to proceed with the Bills for the co-ordination of London Traffic which passed the House of Commons last session but had not time to be examined in the House of Lords. Mr. Morrison said that the Government was, however, fully alive to the importance and urgency of the problem of London traffic, and was ready to explore it further at once with all the interests concerned.

THE new tramways manager of the Manchester Corporation, Mr. R. Stuart Pilcher, formerly of Edinburgh, proposed the provision, at an expenditure of £110,000, of sixty new double-deck motor-omnibuses to take the place of tramcars on a circular route of 8½ miles in the northern and southern suburbs. It is pointed out that the discontinuance of electric overhead traction would relieve the Tramways Committee of its obligations to contribute one-half of the cost of necessary street improvements on tramway routes, and of much expense in the maintenance of road surfaces, and the only set-off would be the cost of removing rails and overhead equipment once the change to motor-omnibuses had been decided on.

THE Ministry of Transport railway statistics for March last gave also the figures for the March quarter. They showed, compared with the corresponding period of 1928, that there was an increase of 0·8 per cent. in the number of passenger journeys, but a drop of 0·3 per cent. in the receipts from passengers and of 1·2 per cent. in passenger traffic. General merchandise traffic decreased by 5·1 per cent. in tonnage and 7·7 per cent. in receipts, and mineral traffic by 5·4 per cent. in tonnage and 5·1 per cent. in receipts. Coal traffic rose 8·2 per cent. in tonnage and 10·7 per cent. in receipts, and, as a consequence, there was an increase of 3·1 per cent. in tonnage but a fall of 0·8 per cent. in receipts. Passenger train miles increased by 0·8 per cent., but the freight train mileage was reduced by 1·0 per cent. The average train load was increased by 3·4 per cent., but that was due to the better loading given by coal traffic.

ACCORDING to the report of the Indian Railway Board, investigations have been continued, with the collaboration of the staff of the Forest Research Institute, into the possibilities of the increased use of various indigenous timbers for sleepers and for coach building. Much useful work has been done, and more can be done, but some years must elapse before definite conclusions can be obtained as to the suitability of all the various species now being tried. Himalayan coniferous sleepers, chiefly chir, have been treated in the North-Western Railway sleeper treating plant. That plant plays a very important part in the sleeper supply of Northern India, and has had considerable influence in regulating the price of deodar sleepers. The Railway Board has sanctioned the erection by the East Indian Railway of a kiln seasoning plant of the Sturtevant type with an annual capacity of 3000 tons of converted timber. The timber will be distributed among the four State railways for carriage building and repair work, and in that way much valuable knowledge will be obtained concerning the suitability of these timbers.

Notes and Memoranda.

A SERIES of systematic feeding trials on dogs and rabbits carried out by Dr. L. V. Blina, of the University of Milan, has, according to the *Chemical Trade Journal*, convinced this worker of the absolute non-toxicity of titanium oxide and titanium sulphate. It is stated that the pigment causes neither digestive disturbances nor is it absorbed by the intestinal tract. Dr. Blina also kept under observation a number of workpeople from an Italian titanium oxide factory and in no case was any harmful effect due to the pigment discovered.

ACCORDING to the annual report of the South African Mines Department, the question of fuel is presenting increasing difficulties to mines in more settled areas away from the railway. Mines on the railway can, and do, use coal, but properties remote from the railway line have no alternative to the use of wood, either direct or in the form of charcoal, and the thinning of the timber supplies in such parts of the country is giving occasion for anxiety. It is satisfactory to note that the use of suction gas plants is extending, but many mines are not in a position to provide themselves with new and expensive machinery, nor do the mines themselves in all cases justify a large capital expenditure, for most of the smaller undertakings are of the ephemeral kind.

IT is laid down, in a copy of the Code of Protection against Lightning, which we have received from the United States Bureau of Standards, that ships' rigging made of metal "shall be effectively grounded at the lower ends in all cases—that is, whether the vessel is equipped with a radio antenna *or* not—except where such rigging or Jacob's ladders are broken up into insulated sections not over 10ft. (3·05 m.) in length for radio purposes by means of suitable insulators, in which case grounding at the lower ends is not necessary. Grounding shall be carried out by means of stranded wire shunts ¼in. (0·635 cm.) in diameter, around deadeyes, lanyards, shackles, rigging screws, thimbles, &c., these shunts to be stranded, laid around the bright rigging, then parcelled and sewed."

A RECENT official report on the explosion of a tube in a water-tube boiler at Brierley Hill, Staffs., emphasises the necessity for providing boilers with good feed water. The boiler was not overworked, and occasionally stood under banked fires for some time. It was also well cleaned at regular intervals. It appears, however, that the feed water, although it was passed through a separator, deposited sludge in the tubes when the fires were banked, and the circulation was consequently sluggish. One tube, presumably, failed on this account. The Surveyor remarks in his report: "That it was found necessary to renew, owing to distortion, the bottom row of tubes twice in such a comparatively short space of time, shows that the boiler was not being worked under favourable conditions. That serious trouble had been avoided previously was, I think, due to the systematic and thorough manner in which the boilers had been cleaned."

ALTHOUGH there is a fairly long list of tantalum mineral ores, few are of importance. Columbite is by far the most common and the most important; it is a very variable tantalate and columbate of iron and manganese, which may contain almost no tantalum or almost no columbium. If the quantity of columbium is very small, the mineral is known as tantalite. The content of iron and manganese may also vary. If a tantalite contains almost no manganese, it is dense black and is called tapiolite—also known as skogbolite. If manganese is present to the almost total exclusion of iron, the mineral is a beautiful translucent red and is called manganotantalite. Antimony or calcium —lime—may be present almost to the exclusion of manganese and iron, and the minerals are then known as stibiotantalite and calciotantalite respectively. The elements named above are only the principal elements occurring in these minerals. All the tantalum-columbium minerals contain small quantities of other elements.

A RECENT food investigation report describes direct measurements of the rate of leakage of heat into the insulated spaces of an actual ship. While accurate data of the thermal conductivities of common insulating materials are available, they are not in themselves sufficient for the needs of the designer of refrigerating plant, because the structures involved in the leakage of heat, particularly in the case of ships' holds, are too complicated to lend themselves easily to calculations of the heat flow. The experiments described are therefore an attempt to supply a very practical need. The results refer, strictly speaking, only to the particular ship in which the experiments were carried out, and to the particular set of conditions obtaining at the time. The ship was, however, a representative one, and the data presented in the report should be of practical use in assisting the decision which always has to be made between space for insulation and space for cargo, and between the cost of insulation and the cost of refrigerating capacity. The report can be obtained from H.M. Stationery Office, price 1s.

THE report for 1925–26 of the geodetic branch of the Survey of India, which is dated July, 1928, gives a record of much work. Geodetic triangulation was resumed with work in Lower Burma, after an interval of eight years. Previous work in that area dated from 1875. High-precision levelling occupied several detachments. Tidal observations with automatic gauges were continued at eight ports. There are now more than fifty stations in Indian waters, including the Persian Gulf and Red Sea, at which automatic tidal observations have been taken for a number of years. Among other interesting matters on which the report touches is the value of bench-marks on trees. In Canada such bench-marks have been used. Their constancy has not been tested with any permanent mark of the land established in precise levelling, but the topographical survey does not disfavour their use. At Dehra Dun experiments have, according to *Nature*, been made on tree bench-marks and eleven of them have been connected at intervals, during twelve years, with the standard bench-mark in the Geodetic Office grounds. The conclusions of those tests are that for secondary precision, as in irrigation work, a tree bench-mark is sufficiently good, but is not constant enough for lines of high precision. In all cases the mark should be placed on the heart wood and not on the bark of the tree.

Miscellanea.

THE river Tamar is to be dredged above Saltash Bridge for the recovery of tin.

A NEW factory, for the production of Triplex glass, is to be put up at Eccleston, St. Helens, by the Pilkington Company.

A TUNNEL, which has for its object the elimination of railway crossings, is to be constructed under Vancouver at a cost of 1,720,000 dollars. It will be 6140ft. long.

THE last rivet in the central span of the new bridge connecting the city of Montreal with the south shore of the St. Lawrence, the first beam of which was placed three years ago, was driven on Wednesday, the 10th inst.

IT has been decided that a factory for making artificial silk should be erected near Preston by Courtaulds, Ltd. It is expected that the works will employ about 5000 hands, and the Preston Corporation has agreed to provide the sewage accommodation necessary to deal with the effluent of the works.

THE first section of the tunnel under the Detroit River, between the United States and Canada, has been sunk into the bed of the river. These sections, which are about 250ft. long by 35ft. in diameter, are precast and are being towed into position in a trench which has been dredged across the river.

THE Secretary for Mines announces the publication of a report on an investigation, carried out at the Department's testing station, into the safety of miners' electric cap lamps when the battery is short-circuited. Copies of the report, price 2d., by post 2½d., may be obtained from H.M. Stationery Office.

A SPECIAL list in the current number of the *Readers' Bulletin*, prepared by the Gulson (Central) Library, Coventry, is devoted to the subject of machine tools. There are nearly eighty entries, but some of the references are to pamphlets and some to books issued by manufacturers. Many of the publications are of American origin.

THE Government of Ontario, Canada, is pushing ahead with its programme to provide electricity in rural homes. Last year, 960 miles of transmission lines were erected in farming districts, and this year the mileage added will be 1200. What is described as being a service that meets very completely the requirements of the average farmer is being furnished for £1 5s. a month in some typical districts. This service includes lighting the house and all farm buildings, driving three separate motors for pumping water, chopping and cream separation, besides providing power for electric iron, washing machine, &c.

THE famous training ship "Mars" has been sold to Thos. W. Ward. Ltd., Sheffield, and has now been towed to Inverkeithing to be broken up. Originally she was an 81-gun line-of-battle ship, was launched in 1840, and served in the Baltic during the Russian War. Owing to the introduction of heavy ordnance, the "Mars" was transformed into a 61-gun ship, and after a short life in the Navy was stationed in the Tay as a training ship for boys in 1869. During the last sixty years the vessel has been a picturesque landmark on the river and the home of thousands of boys scattered to all parts of the world, many of whom now occupy honoured positions.

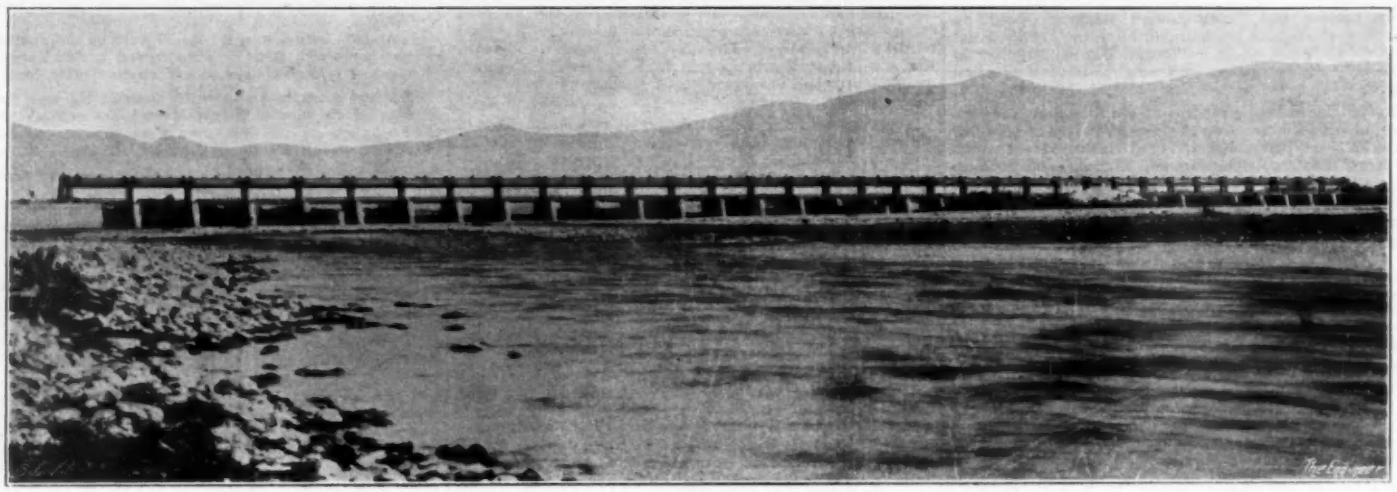
THE President of the Board of Trade has appointed a Committee to consider the increase during recent years in the number of deaths ascribed to poisoning by coal gas supplied for domestic purposes, and to make recommendations as to any measure relating to the production and use of gas for domestic purposes which might be taken with a view to diminishing the number of such deaths. The Committee consists of:—The Rt. Hon. Sir Evelyn Cecil, G.B.E. (chairman), Sir John Robertson, C.M.G., M.D., Professor R. V. Wheeler, D.Sc., F.I.C., and Mr. F. J. Wrottesley, K.C.; with Mr. H. L. Spencer, of the Board of Trade, Great George-street, Westminster, as secretary.

A TOTAL of 50,073,450 tons of ore was treated in the United States by the flotation process in 1927, according to figures collected by the Bureau of Mines. By far the greater portion, 40,881,768 tons, consisted of copper ores. The remainder was made up of complex lead-zinc, lead, zinc, copper-iron and miscellaneous ores. A total of 220,514,373 lb.of reagents was reported as being consumed in the treatment by flotation of all classes of ores. The bulk of this consumption was lime, of which 169,926,145 lb. were required. Pine oils constituted the greater portion of the frothing reagents used, accounting for 5,064,320 lb. of a total of 6,583,151 lb.; appreciable amounts of cresols were also used. Of the oils used as collecting reagents, coal tar creosotes and coal tar made up 2,655,352 lb. of a total of 3,508,993 lb. Other oils used as collecting reagents were wood-tar creosote, crude oils and petroleum products, blast-furnace oils, water-gas oils and tars, and miscellaneous and reconstructed oils. Ethyl xanthates and di-thio-phosphoric acids were used as collecting reagents to the extent of 3,319,639 lb. and 1,932,996 lb. respectively.

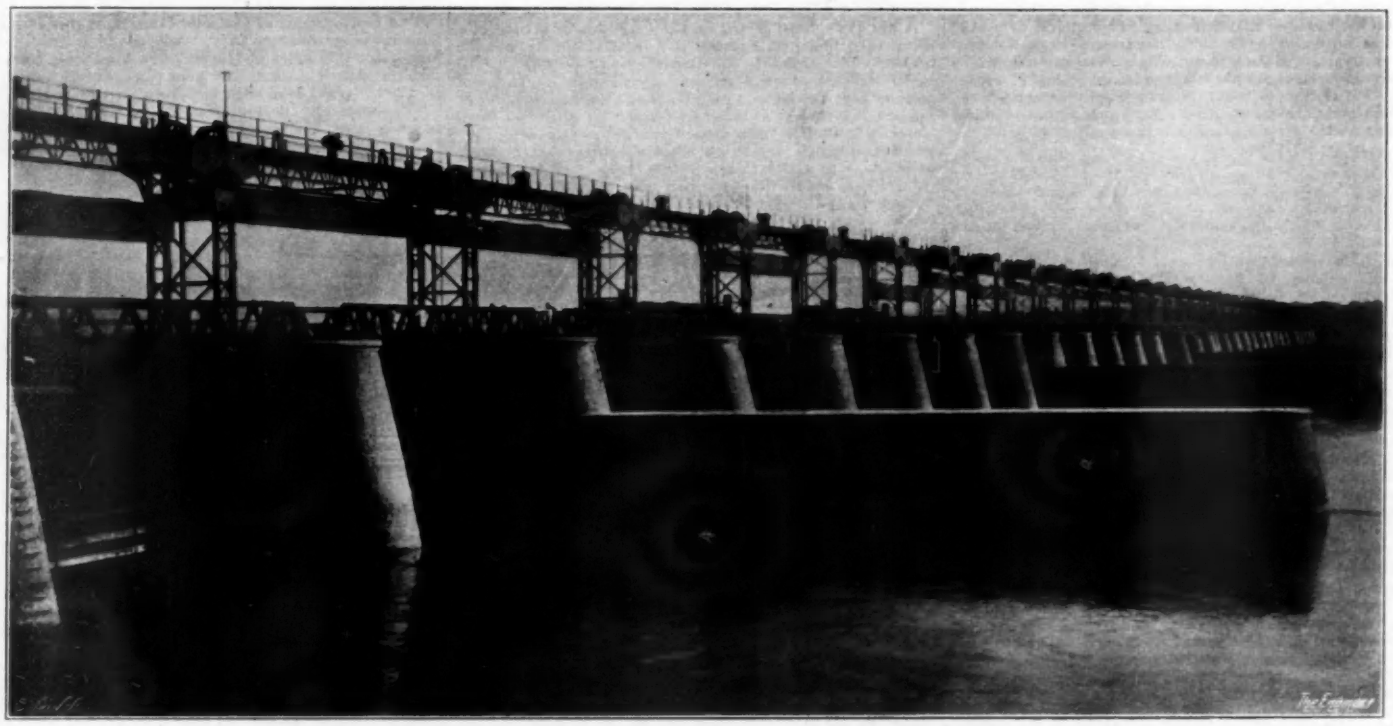
THE final returns for the mineral production of British Columbia for the year 1928 show that the output was the greatest on record, although the monetary value was not the maximum. In all, 6,241,310 tons of metalliferious ores were mined, as compared with 5,416,621 tons in 1927. Copper, lead and zinc are British Columbia's most valuable metals in point of value of total output. In all three new production records were established. Copper with 97,908,316 lb., valued at 14,265,242 dollars. compared with 89,202,871 lb., valued at 11,525,011 dollars in the previous year. An increase of over 22,000,000 lb. was shown in lead production, the output for 1928 being given as 305,140,792 lb.; the value for last year at 13,961,412 dollars, however, represents a reduction from 14,874,292 dollars, which the 1927 output was worth. A very large increase was shown in zinc output from 145,225,443 lb. in 1927 to 181,763,147 lb. last year. The value of zinc output increased from 8,996,135 dollars to 9,984,613 dollars despite the lower prevailing prices for this metal. Coal ranked ahead of zinc, being third in order of value among British Columbia's products of the mining industry. A slight increase is recorded in output with 2,526,702 tons mined worth 12,633,510 dollars.

THE SARDA RIVER IRRIGATION SCHEME

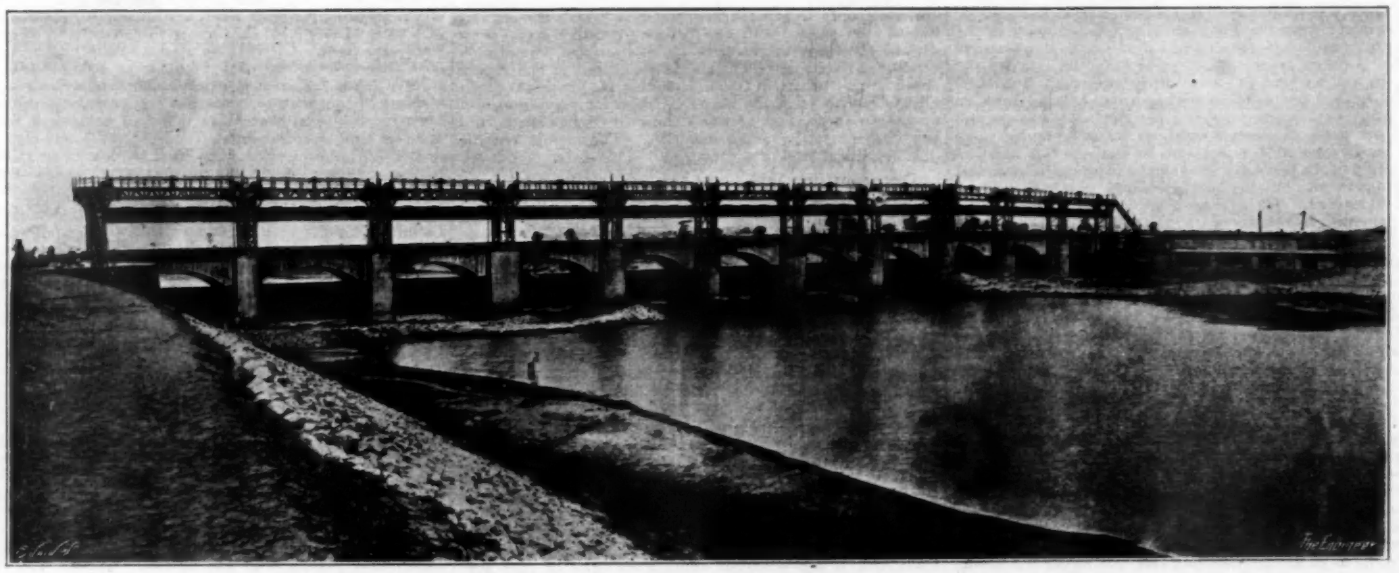
(*For description see page 48*)



GENERAL VIEW OF THE BARRAGE AT BANBASSA



BANBASSA BARRAGE, SHOWING SLUICE GATES AND TRAINING WALLS



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THE ENGINEER.

JULY 12, 1929.

Conventions.

THIS is not about the conventions which are forced upon a tolerant society by the late Mrs. Grundy, nor about the conventions of art, music, and literature through which a coach and four has been driven by modern exponents, nor about conventions as the lawyers mean them, but about conventions in the primary meaning of the word—a formal assembly of delegates for some special purpose. It is a very old word in that sense and has been retained by America, which shows a leaning to the archaic use of words, but in this country has been almost replaced by conference or congress. In the United States the specific purpose of many conventions is little more than the bringing of hundreds, even thousands, of people together for social intercourse. Conventions of the kind are encouraged by cities, railways and, particularly, by hotels which live, so it is said, upon the flood of conventionists that sweeps through them with little intermission throughout the whole year. Whether it is due to this American example and influence, or to some more general cause, the fact is patent that conventions and congresses increase yearly in number and have already become a real burden to the busy man. Were he obliged to attend only the national conferences and congresses, the condition would be serious enough, but that is not the end of his labours. International conventions have assumed an even greater importance and are even more exacting, as they entail the personal attendance of the most influential and busiest people connected with industry or science.

It is little to be wondered at, then, that Mr. C. P. Sparks, speaking from the chair at the banquet on Thursday, July 4th, to the delegates of the International Electrotechnical Committee, who are now assembled in London to discuss steam turbines, the rating of electrical machinery and other matters, should have animadverted upon the burden that such gatherings have become and the danger that the electrical field internationally is in danger of "becoming confused owing to too many international congresses and conventions." The difficulty has, indeed, been recognised, and there is in existence a special Committee d'Entente whose business it is to consider the programmes submitted and to arrange dates. But we doubt if it has any power to suppress congresses, save by tacit discouragement, and as "the sight of means to do ill deeds makes ill-deeds done," it may even become the involuntary agent in the increase of congresses and conventions. Some stronger line of action is needed. The multitude of congresses, as Mr. Sparks said, is bound increasingly to lead to overlapping. "Moreover, it is a heavy tax on both the manufacturing and professional interests to send representatives to attend these innumerable meetings, and yet they are forced to do so as they are bound for their own interests to maintain touch with international opinion." We might go even a step further. They are bound to go not only to maintain touch with international opinion, but to retain foreign trade and to support the prestige of their own countries. Consider, for example, the double convention which takes place in Japan this autumn. With relative ease a large party of American engineers is attending it. No one can doubt for a moment that they will take every possible advantage of their intercourse with Japanese engineers to impress upon them the importance of American engineering. To counter that action—of which no one would think for a moment of complaining—the countries of Europe, to whom the visit is much more costly in time and money—must also be represented as capably as possible. That aspect of conventions —may we call it without offence the national propaganda aspect—is one of the causes which make international conventions so exacting. And we see no means of circumventing it. A purely scientific international congress, a congress which has absolutely no other effect than the establishment of scientific truth, and of which the delegates have no other object at the back of their minds is almost —not quite—unthinkable in the field of engineering, which is essentially an industrial pursuit. One may get it in astronomy, in physics, in medicine, in law, but rarely or never in engineering. But altogether apart from this aspect, the overlapping to which Mr. Sparks refers is a constant challenge to efficiency. Let us quote a remark made by Professor Feldmann, of Delft, President of the International Electrotechnical Commission, in his reply to Mr. Sparks: "I am fully aware," he said, "of the dangers of the existence of so many independent international organisations in the same field which approach each other sometimes and sometimes trespass on each other's work. This is particularly the case if the scope attempts to be all-embracing; then, of course, there is some danger that the work accomplished will not bear any direct ratio to the effort expended; one may fall by one's own weight."

A great deal of the work now being done by international conventions is of an invaluable kind. But the best of it can be carried out by quite small committees—the smaller the better—of expert delegates. The conference on international steam tables which is now proceeding in London is a case in point. There a few delegates from a few countries are endeavouring to come to a general agreement upon scientific facts. Of another kind are some of the investigations carried out by the I.E.C. itself, which aim at the establishment of a common basis for tenders for electrical machinery from all parts of the world. Such things as these can be done quite effectively by a few men, and though they must, if multiplied, make undue calls upon the time of busy people, they need not, and they do not, affect large numbers. The fact is that the large conventions are a habit rather than a necessity, and have often more social than scientific or industrial value. It is only necessary to observe that the participants wear a holiday air and are often accompanied by wives and daughters to recognise that they are of no more serious importance than summer meetings. It is the committee that does the useful work, and it ought not to pass the wit of man to prevent overlapping in them and to keep the number of meetings in any one year down to a minimum so as to ensure that the work accomplished does bear a direct ratio to the labour expended.

Help for the Railways.

THE whirligig of time brings many changes and some remarkable developments. Who would have thought when, less than twenty years ago, railway shareholders and railway officers were struggling against "recognition" of their men's trade unions, when they protested that outsiders' interference with the administration meant ruin, and when no word was bad enough for the unions' officials,

that the most abused of the men's leaders would now be the medium through which the long-desired and long-needed assistance is to be given to the railways. But let it not be forgotten that, in their hearts, most of the railway officers would have welcomed "recognition" as a means of discussing matters with the men, could it have come in some other way than by being forced upon the companies by, in particular, Mr. Lloyd George, who, in his less responsible days, never had a good word for British railways. When, after the threatened strike in 1907, a conciliation scheme was evolved, it was spoilt by the extreme demands put forward, and the general railway strike of 1911 was the result. That event brought to the men a more reasonable spirit, which, in turn, won the sympathy of the companies' representatives, and, as we have on more than one occasion remarked, in no trade were the relations between masters and men happier than on the railways. For that pleasing change of affairs no little credit is due to the new Lord Privy Seal, Mr. J. H. Thomas, the railwaymen's leader. Mr. Thomas has the great gift of being able to see both sides of a question; he knows the men's needs, duties, and responsibilities; but, equally so, he appreciates the companies' position. He is fearless, too, in that he is not afraid, when satisfied on a point, to take up an unpopular attitude with the men. But, whilst he may be *fortiter in re*, he is also *suaviter in modo*, and, with that diplomacy which long experience in negotiation has given him, he is able to give satisfaction to both sides. And now that fairness and that appreciation of the companies' difficulties has brought him a great reward, in that, in the great responsibility that has been thrust upon him, to foster and encourage trade and to find work for the unemployed, the railways know that he is fully aware of their ability to assist, of the difficulties that at present stand in the way of their rendering that assistance, and of the ample return that would come from any help that could be given to them.

We had occasion to mention this subject in a leading article in our issue of April 26th after Mr. Churchill had announced in his Budget speech that, in return for the abolition of the railway passenger duty, the railways were prepared forthwith to spend the capitalised equivalent of the amount thereby saved. The question of relief for the railways then entered the political field, as a plank in the platform of all political parties in the General Election, and we deemed it wise to leave it alone. It would be interesting to compare what Mr. Churchill said the companies would do with what Mr. Thomas tells us. But it must suffice to say that the programme now—apparently after the railways have had time to consider the matter more fully—is more definite and reasonable. Six and a-half millions are to be spent on new engines, extensions of sidings, development of railway stations and better goods equipment. Then, in the immediate future, besides the Charing Cross Bridge scheme, it is proposed to tackle the question of the electrification of the lines into and out of Liverpool-street, and the extension of the Piccadilly tube railway from Finsbury Park and an Outer London Railway. These are all practicable schemes. The new locomotives are, no doubt, those that are required in the ordinary way to meet the demands of service; by the extensions of sidings we are probably to understand the construction of more marshalling yards equipped for hump shunting and fitted with car retarders; whilst the goods equipment is likely to be the provision of containers and labour-saving appliances, which we may recall were features in the too-ambitious scheme of the late A. W. Gattie. It is safe to say that the electrification of the former Great Eastern suburban lines is one of the most pressing transport needs connected with London traffic. It has long been discussed, and would no doubt have been agreed to and by this time might have been carried out, but for the financial difficulties. The Finsbury Park extension is another great need, but it is in the happier position of having been accepted by the Underground authorities. They, however, now find themselves embarrassed by the fact that their traffic pooling scheme, which passed through the House of Commons last session, has been rejected by the Minister of Transport, who has announced that the Government cannot support it, so that the whole question of the co-ordination of London traffic is again to be investigated. The Outer London Railway is another great need. Much money has been spent in the past in efforts to get parliamentary sanction for such a railway, but the rivalry of the companies, which were then competitors, but are now more closely allied, killed it. We will not, on this occasion, say more about the privately owned truck and the high-capacity wagon. Mr. Thomas, on the ground that he preferred to wait for the report, would not discuss it, and so we, too, refrain. We must, however, remark that as it is now over two years since the Committee to consider the question was appointed, it cannot be as simple a matter as is generally thought. The high-capacity mineral wagon cannot come into general use till all the ports in the country have equipment to accommodate it, and the buying out of the privately owned wagons is too costly to contemplate. The gradual replacement of privately owned wagons as they fall out of use by company-owned wagons is a more reasonable and practicable course.

In conclusion, one word must be said in justice to the companies. It is that they are not needing assistance because of any inefficient management. Mr. Thomas himself has testified as to that. Speaking at Crewe on May 8th he said that he could not subscribe to the view that the railways of this country were either out of date or managed by an inefficient and incompetent body of people. Were, let us add, definite proof of that contention required, it could be seen in the table published on page 498 of THE ENGINEER of May 3rd last, which showed that the fall of nine millions in traffic receipts last year was countered by a saving of seven millions in the expenditure.

Reports on Thames Floods.

THE Air Ministry has just issued as Geophysic Memoir No. 47 of the Meteorological Office, a publication containing a "Report on Thames Floods," by Dr. A. T. Doodson, of the Tidal Institute of the University of Liverpool, and "Meteorological Conditions Associated with High Tides in the Thames," by Mr. J. S. Dines, Superintendent of the Forecast Division of the Meteorological Office. Both these documents are of considerable interest, and in what follows we propose to give an outline of their contents.

As a result of the disastrous floods experienced in the Thames on the night of January 6th–7th, 1928, the Tidal Institute of the University of Liverpool was requested to undertake an investigation of the causes of such floods, with a view to an answer being provided to the question: What is the reasonable probability of the occurrence of a tide of a height approximating to or exceeding that of January 6th–7th?

Dr. Doodson explains, at the outset of his report, that previous experience of such problems had led to the belief that the large perturbations of sea level and tides are not necessarily locally generated, but depend upon oscillations set up in the main basins, and that full satisfaction could only come from a study of the storm surges all round the North Sea, and even along the Atlantic seaboard. A more limited investigation, however, was, he says, urgently required in order to provide a possible basis for forecasts of such effects, and, therefore, a preliminary investigation, dealing with the meteorological conditions, which are most favourable to the production of storm effects on high water, was suggested. For that purpose it was proposed that all storm surges for the last ten or twenty years should be examined in relation to (*a*) the types of barometric pressure systems, (*b*) the position and lines of travel of cyclonic centres, and (*c*) the time relation between the maxima of the storm surge and ordinary tidal oscillation. A statistical study of the meteorological perturbations of sea level, on the lines of one already published for Liverpool, was also suggested. Such a study is concerned, primarily, with the slow variations of general sea level—taken over a whole day—and *not* with the quickly varying effects usually experienced in connection with a storm. Such a method lends itself to the study of time relations between the variation of sea level and the variation of wind and pressure, not only locally but elsewhere, and consequently the most effective winds, and the places where they are most effective, can be deduced.

Dr. Doodson divides his report into four parts:—Part I.: "Study of Storm Surges"; Part II.: "Statistical Investigations"; Part III.: "The Effects of Land Water"; and Part IV.: "Probabilities," and there are three appendices.

Part I. is subdivided into nine sub-sections. In the first the classification of disturbances is considered. From tide gauge records supplied by the Port of London Authority the variation in tide levels at Southend were examined and tabulated, Southend being chosen because the tides there are more easily predicted than at London Bridge, and it was desired to compare the observations hour by hour with "predictions" obtained on the tide-predicting machine. The immediate result of that work was to reveal that many large disturbances occur; 5ft. is quite common, 7ft. to 9ft. occur fairly frequently, and over 11ft. was experienced on one occasion. "Obviously," remarks Dr. Doodson, "if it is possible to get 11ft. superimposed on high water, a most important fact was revealed, and one which would dominate the discussion concerning the raising of defences." Fortunately, such a happening appears to be unlikely. In January last the maximum of the storm surge (5ft.) occurred a little before high water, and in most of the cases considered the favourite time of occurrence seemed to be about two to three hours after low water.

The next stage of investigation was to study the meteorological conditions, as indicated by the synoptic charts issued twice daily by the Meteorological Office. The phenomena were classified into four types:—

Type I.: A cyclonic depression forms west of Scotland and travels to the Baltic, the wind veering from S.W. to N.W. or N.

Type II.: A cyclonic depression travels over the Flemish Bight.

Type III.: The winds are steady for a long time, the isobars running almost parallel to one another in a north-west direction over very large areas, with steady N.W. winds.

Type IV.: The south-westerly type, corresponding roughly with Type III., but with S.W. winds.

In most of the cases in which very large storm surges have been experienced in the Thames, the weather conditions have been of Type I. From January 5th to 8th, 1928, they were of that type, and the time of maximum surge was when the centre of the disturbance was over the Baltic Sea.

The early results of the statistical investigation tended, as had been anticipated, to show that the winds operating over the Atlantic Ocean are equally as important as those operating over the North Sea, and it therefore seemed unlikely that the storm surges would be associated with any single type of pressure disturbance. It was therefore decided to investigate conditions a little further afield, though that work had not been contemplated as part of the preliminary investigations.

Accordingly, with the aid of the Hydrographic Department of the Admiralty, tidal movements at Dunbar, Felixstowe, and various points in Belgium, Holland, Germany, and Denmark, not only for January, 1928, but for other years, were inquired into. The results, which are illustrated by means of curves, were most interesting. The surges experienced at Flushing and the Hook of Holland were, if anything, a little earlier than at Southend. That at Ymuiden was definitely later than at Southend, and it would appear that at 2 a.m. (G.M.T.) on January 7th the surge was retreating in a northerly direction along the continental shores, and that conclusion was verified readily, the surge reaching its maximum about 3 a.m. (G.M.T.) at Norderney, 7 a.m. and at Esbjerg at 11 a.m., while a similar result is also in evidence at Hirshals, in the Skagerrak. Incidentally, it is noted that at all places there is evidence of a smaller and earlier surge travelling in the same way.

Among the conclusions arrived at in this part of the inquiry were (*a*) that apart from purely tidal effect, a local wind will probably have most influence at low water and will tend to give maximum results between then and high water, and (*b*) that since there is distinct evidence of such surges reaching a maximum of 7ft., it must be concluded that there is a definite possibility of such a surge becoming coincident with local high water, with disastrous results. The probability of such an occurrence is another matter.

After discussing, in Part II., certain technical points, such as time lag, &c., the Report passes on, in Part III., to consider the effects of land water, and the conclusion is arrived at that at London Bridge, when 10,000 million gallons of water per day are passing over Teddington Weir, "the general level of the river is raised by 0·8ft. to 1·0ft. and that the variations in land water are not of primary importance in connection with the possibilities of floods in London, though it has to be granted that 1ft. may make all the difference between safety and disaster if a storm surge is superposed with it on high water."

The probabilities of the recurrence of floods is then discussed mathematically in Part IV. Briefly put, the conclusion arrived at is that the probability of similar floods in the Thames taking place every eighteen years on the average is much too high, and that, apparently, the probability is not likely to be much different from about one in sixty years.

METEOROLOGICAL CONDITIONS ASSOCIATED WITH HIGH TIDES IN THE THAMES.

In his Report on the meteorological conditions associated with High Tides in the Thames, Mr. Dines states that past records show that the waters of the Thames had not reached the height attained in London in January last at least since 1881, and that there had been no tide in the period of forty-seven years from 1881 to 1927 of a height sufficient to overflow the top of the Thames defences at their present level. "Thus the phenomenon which it is desired to forecast has occurred once in about fifty years."

In carrying out his investigation Mr. Dines studied vast masses of data, and we have not the space to follow him through his remarks on the nature of all of them and of the conclusions he drew. Reference may, however, be made to seventeen cases which were picked out by Dr. Doodson as the result of his consideration of the Southend tide records. These

seventeen cases were spread over a period of thirteen years. Mr. Dines, on searching the meteorological records on the occasions of each of these cases, divided them into the following groups :—

(1) Seven cases in which strong westerly winds over the Atlantic to westward of Ireland or Scotland, decreased or veered prior to the setting in of a strong north-westerly or northerly wind over the North Sea.

Mean maximum departure from predicted level, 6ft.

(2) Two cases in which strong southerly winds over the North Sea preceded north-westerly or northerly.

Mean departure, 6½ft.

(3) Six cases in which strong north-westerly or northerly winds set in over the North Sea without prior wind action.

Mean departure, 6ft.

(4) Cases in which strong westerly winds prevailed over the Atlantic and North Sea.

Both departures, 4ft.

Detailed consideration of all the cases led to the proposal of the following rule for the forecasting of a raised water level at Southend :—

Conditions for a raising of the water by 4ft. or more above the predicted level at Southend :—The onset of a geostrophic wind over a considerable part of the North Sea of 60 m.p.h. or over between N.W. and N.

Such onset, it is explained, is likely to be followed within a period of 7–16 hours by a large positive departure of the water from predicted level. The fact that the wind over the extreme southern North Sea may be westerly with no north component is no bar to the occurrence of a raised water level, so long as the requisite N.W.–N. wind exists over other parts of the area. A favourable occurrence appears to be the existence of either

(1) Westerly gales or strong winds west of Ireland or Scotland, which veer or die away shortly before the onset of the wind over the North Sea ; or

(2) Southerly gales or strong winds over the North Sea, preceding the northerly wind.

This rule should be regarded as applicable only during the winter six months, October to March, since large positive disturbances of the water level are not found to occur during the summer half of the year.

Having drawn up this rule, it remained to test it by observing how satisfactorily it would serve to give warning of all cases of a marked rise in the waters of the Thames, and, further, how many needless warnings would be given. After investigation it was discovered that the application of the rule, even by one having no previous acquaintance with the subject, would lead to the forecasting of fourteen cases of marked disturbance of the level out of seventeen. Then as regards false alarms. On seventeen days in twelve winters the water level at Southend was raised more than 4ft. above prediction. On fourteen of those occasions a warning could have been issued by following the rule given above, while about fifteen false alarms would have been sounded.

The remarks made by Mr. Dines concerning the foregoing are that the situation revealed by the figures is much more satisfactory than was anticipated when the work was begun, and that, if every positive disturbance of 4ft. or over, resulted in a Thames flood, it would be clearly practicable to issue warnings which might be successful in a sufficient percentage of cases to be of considerable value. But, he adds, "the fact remains that only one serious flood has occurred during the past fifty years, which is very different from the seventeen cases of raised water at Southend in twelve years."

The discrepancy is due to two causes :—

(1) Floods do not occur at times of neap tide. At such times the water at London Bridge only rises to some 17ft. or 18ft. above Admiralty datum and a disturbance of 9ft. would need to be superimposed on the predicted tide to cause danger of a flood ; and

(2) Every positive disturbance of 4ft. or over, even at the time of spring tide, does not cause a flood.

There is much more of interest in both these reports than we have been able to indicate, but we must leave it to those who are sufficiently interested as to require further information to obtain it by acquiring a copy of the publication, which may be purchased from H.M. Stationery Office, price 2s. 6d. net, and we conclude by quoting the last paragraph of Mr. Dines' Report :—

"A close association has been found between geostrophic winds of 60 m.p.h. and over, from the N.W. or N. over the North Sea and a raised water level at Southend, and it is considered that it would be practicable to issue forecasts of a disturbance in the water level amounting to 4ft. or more above the predicted height. It is, however, found that such disturbances tend to occur at half tide and to avoid high tide, thus nearly always passing without danger of flooding. The reason for this has not been ascertained, and without further knowledge it does not appear possible to issue useful warnings of Thames floods at the present time."

Literature.

Estimating. By T. H. HARGRAVE. Sir Isaac Pitman and Sons, Ltd. London : 1929. Pp. 120. Price 7s. 6d. net.

THE lot of the estimator is not an easy one ; he is for ever navigating troublous waters, with the Scylla of over-estimation and the consequent loss of orders on the one hand, while on the other is the Charybdis of under-estimation, resulting in a financial loss to his firm. The writer on estimating has a somewhat difficult task, for although, as the author justly says, "a good estimating department has been described as a sound insurance policy," it is still uncertain where the functions of that department begin and end, and no recognised standard book of reference on the subject exists. For this reason Mr. Hargrave is to be congratulated on having produced a work that purports to be exclusive to the subject, and suitable for the average engineering student.

Chapter I. introduces the subject, and gives the author's conception of the ideal estimator ; Chapters II., III. and IV. deal with the important consideration of material estimation, including forge and foundry products. Chapter V. may be regarded in the light of a parenthesis devoted to planning and methods of production. Chapters VI. and VII. describe the problems incident to wages and the times taken on various operations, while the main concern of Chapter VIII. is overhead charges and the different ways of distributing them. Chapter IX. contains twelve specimen estimates set out in summary form, and in Chapter X. we find a discussion on delivery charges, overtime, &c., which must naturally be taken into account in the compilation of an estimate. Chapter XI. gives a very fair sketch of the organisation of an estimating department, and Chapter XII. completes the book by the consideration of several disconnected branches, such as specifications, approximate estimates, reconciliation of estimate and cost.

We are of opinion that a rearrangement of the chapters is desirable, and that after a general introduction the author would be well advised to proceed at once to a consideration of the organisation of his estimating department. After reading the book through we are driven to the conclusion that his apprehension of the principles of functional management is distinctly hazy. Although he rightly suggests when discussing organisation that the drawings "may be handed over to the rate-fixing section, who will supply the necessary figures" for wages, elsewhere in the book we find the estimator himself saddled with the task of determining what the wages will be. Indeed, the author takes him still further afield, for he appears as cost accountant, planner, and jack-of-all-trades, so that whatever he is, he will certainly be but an indifferent estimator. While we should not cavil at both estimating and ratefixing coming under the control of the chief estimating engineer, they must remain distinct functions, the ratefixer dealing with all the detail work incident to price setting even to the smallest unit, leaving to the estimator a wider vision, ever bearing in mind the finished product. In the absence of a separate department, planning should be incorporated with ratefixing, as the two functions are more analogous than estimating and planning.

Obviously cost accounting is a very distinct control, and in the well ordered factory the cost accountant will furnish the appropriate rate to be levied for overhead charges. To our mind it is axiomatic that estimating and cost accounting must go hand in hand, for a moment's thought will show that unless they do, the basis on which the cost of the finished product is determined may differ from that on which the estimate is built, with disastrous results. We agree that "it does not always follow that our estimator need blindly follow the overhead rates supplied him by the accountant," but we suggest that it is advisable when he decides on another rate to obtain the concurrence of the cost accountant.

Having initiated the student into a sound organisation, it is necessary to emphasise the desirability of taking full advantage of the statistics rendered by the accountant, and to investigate carefully the comparison between estimated and actual cost. The form shown in the author's Fig. 39 could be improved by placing the estimate immediately above or below the actual cost, instead of beside it, thereby facilitating comparison between the respective headings of material, wages, and overhead. The author's remarks on the value of the use of charts and diagrams are quite sound. The estimator by plotting cost per unit may be able to obtain a curve that will be useful for the purpose of checking a thoroughly considered estimate, but it will prove still more valuable in the case of those rough-and-ready estimates which are the best that can be furnished on account of the short time available for their preparation, but which are nevertheless bugbears to the conscientious estimator.

"Estimating" teems with contentious matter, and we should like to join issue with Mr. Hargrave on a number of different points ; in some cases he is too vague, such as on the very vital question as to the manner in which jigs, tools, and other first equipment should be treated. He emphasises the importance of paying attention to the possibility of overtime and night shift, but does not at the same time explain very convincingly how greatly the increased production may lower the oncost and perhaps even produce such a situation that overtime working may be ignored in the estimate. In citing what is the practice in certain businesses with which he has been in touch, he does not clearly indicate whether he endorses or condemns the policy, leaving the student rather "in the air." When he asserts that some concerns have a proportion of their estimators technical men and the others clerical, we should have welcomed an unequivocal statement that clerks cannot be estimators, rather than read "it may be that for standard articles the clerk may be able to produce a satisfactory estimate from existing data." That would not be a true estimate, but a mere quotation, and the two should not be confused. There is plenty of work for the clerk in the estimating department, but it is not as an estimator.

Our criticisms are largely made with future editions of "Estimating" in mind, and not in any way to detract from the usefulness of the book to the student who is only vaguely alive to what is comprised in an estimate. Provided he does not take this work as a guide to general organisation, a careful study of it can certainly be recommended.

The Transactions of the Fuel Conference (World Power Conference), 1928. Three volumes with index volume. London : Percy Lund, Humphries and Co., Ltd. 1929. Price £12 net.

WITH very commendable speed the full reports of the proceedings of the Fuel Conference which was held in September and October last have been published. They occupy three very stout volumes, whilst a fourth volume, not yet ready, is to be devoted to an index. As a work of reference these volumes must for years to come occupy an important position in every technical library. All the papers which were presented at the Conference are reproduced in their original language, English, French, or German, with English summaries of those in the two last-named tongues. The discussions are also given at considerable length. Hence in these three volumes the reader has a conspectus of the whole problem of the economic use of fuel as it stood at the end of 1928. In the first may be found all the papers, forty-eight in number, connected with the coal and oil industries. Amongst them is a series of communications on coal cleaning, a subject which is likely to evoke increasing interest as the value of cleaning coal and the necessity of doing so to reduce the dust problem is more generally appreciated. We may mention that a paper on "Natural Gas as a Source of Power," contributed by the Roumanian National Committee of the World Power Conference, appears in this volume. It is a subject about which relatively little is known, and it may be useful to have a note of the source of some information.

The second volume is devoted to the carbonisation industry and to the utilisation of fuels. It contains no less than sixty-three papers dealing with gas production, coke making and other carbonisation and fuel problems. Here also we find papers on coal and oil for locomotive firing, producer gas for commercial vehicles, electric heating, the domestic uses of coal, and so on. The third volume is a continuation of the second, but carries the subjects further. In it pulverised fuel, internal combustion engines, waste heat recovery, power alcohol, and similar subjects are discussed in fifty-four papers drawn from all parts of the civilised world.

At the time that the Conference took place we endeavoured to give a general idea of the nature of its work, but a complete report of the proceedings was naturally out of the question. Our readers will, however, have gathered from our articles the importance of the Conference, and they will hardly need to be told now that the "Transactions" as published form a veritable international Encyclopædia of Fuel.

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Annales des Travaux Publics de Belgiques, Tome XXX., Facs. 3, Juin, 1929. Brussels : Goemaere, Rue de la Limite, 21.

Public Works Department, Madras Presidency, Administration Report for the Year 1927–29. Part II.: Irrigation. Madras : The Superintendent, The Government Press. Price 5 rupees net.

University of Leeds, Department of Coal Gas and Fuel Industries (with Metallurgy) : Report of the Livesey Professor for the Sessions 1926–27 and 1927–28. Leeds : Published by the University.

Bijdrage tot de Kennis van den Invloed van de Getij-beweging op de Stijghoogte van het Grondwater. By Ir. J. H. Steggewentz, m.i. Being a report—Mededeeling No. 9. To the Rijksbureau voor Drinkwatervoorziening. The Hague, Mawritskade 7. 1929.

Wind Tunnel Tests of Aerofoils with Pilot Planes. By F. B. Bradfield and K. W. Clark, being Reports and Memoranda No. 1213 (Ae. 372) of the Aeronautical Research Committee of the Air Ministry. 1929. Published by H.M. Stationery Office. Price 1s. 3d. net.

Department of Scientific and Industrial Research, Geological Survey of Great Britain : Attrition Tests of British Roadstones. By E. J. Lovegrove, with notes by J. Allen Howe, and Sir John Flett, K.B.E., F.R.S. viii + 84 pp.; 5 plates. London : H.M. Stationery Office (Adastral House, Kingsway, London, W.C. 2). Price 3s. net.

Locomotive Performance.

By E. C. POULTNEY, O.B.E.

No. II. (*conclusion*).*

DYNAMOMETER RECORDS.

STEAM RATE PER I.H.P. HOUR.
CONSIDERING THE MAXIMUM POSSIBLE HEAT CONSUMPTION.

IN considering the performance of a non-condensing engine and especially when comparing one engine with another on a B.Th.U. basis, it seems reasonable to suppose that any diagram showing the heat supplied in B.Th.U. per horse-power hour should be calculated from a given standard temperature of feed water, say, 32 deg. Fah., or any other if more convenient, rather than the actual temperature of the feed water. Furthermore, it would appear that when considering the performance of a locomotive, it is hardly reasonable to charge the engines with the total heat above any standard ideal feed temperature, say, 32 deg. Fah., as given in the steam tables, but rather only with that in excess of 1000 B.Th.U. per pound of steam, inasmuch as no non-condensing engine exhausts less than that amount. With this in mind, Figs. 5 and 6 have been drawn. They give the heat rate per I.H.P. hour above 32 deg. Fah., less 1000 B.Th.U. per pound of steam, plotted against indicated horse-power. Fig. 6, which is for "K 2 s.a.," shows, like the Fig. 5 for "K 2 s.a."—see THE ENGINEER, November 21st, 1924—that the lowest heat rates were obtained at the earlier cut-offs. Though this is generally true, it will have been noticed from C in Fig. 3—"K 2 s.a."—that at the lowest speed—120 r.p.m.—and an output of less than 1000 I.H.P., the economical cut-off is apparently longer than 20 per cent.; although in this connection it must not be forgotten that superheat would be low at low rates of power, and, furthermore, at the higher powers the short cut-offs give certainly the best results. It should be remembered also that at low speed, and hence, low power, to have obtained that same power at any longer cut-off would have entailed throttling, which practice has shown to be wasteful—see THE ENGINEER, November 28th, 1924, Figs. 7 and 8. When comparing water rates on the basis of I.H.P., the very low consumptions per I.H.P. were remarked upon—THE ENGINEER, November 21st, 1924, Fig. 1—and it was noted that the least steam rate per I.H.P. hour was, for the "Pacific" locomotive "K 2 s.a.," as little as 14·6 lb. per I.H.P. when developing 2290 I.H.P. at 320 revolutions per minute, and with a cut-off of 25 per cent. This proved to be the lowest water rate per horse-power hour recorded for any of the tests for either of the two locomotives "K 2 s.a." or "E 6 s," and is believed to be an extremely low steam consumption.

SUPERHEAT AND THERMAL EFFICIENCY.

Fig. 7 gives the superheat attained with each locomotive plotted against the thermal efficiency of each locomotive as a complete unit. That is, the temperatures recorded do actually give the true temperature of all the steam exhausted at each stroke, or whether they refer only to one part of the total discharged.

On this point and quoting direct from Bulletin 18, "Tests of a Class 'K 2 s.a.' Locomotive," the following observations are made in part: "For it is quite certain, as future tests may prove in more detail, that the exhaust superheats shown are misleading in being too high to represent the average superheat of the exhaust steam, for the reason that a very large portion of the steam escapes at a lower superheat, or as saturated, or even as wet steam, between the point of release and the end of the stroke, and before the return stroke has even commenced, so that for much the larger portion of the time of exhaust the smaller portion only of the steam exhausted is exposed to contact with the cylinder walls, which, having been exposed during admission to superheated steam, are at a temperature much above that of saturated steam . . . if the exhaust at the instant of release contained any moisture or was even at a very low degree of superheat, and had been allowed to escape at a uniform rate in the same time, then, with the foregoing in mind, it would seem that the heat furnished by the cylinder wall would not have been sufficient to superheat all of the exhaust steam as much as would appear."

It will be observed—see Fig. 7—that the exhaust temperatures shown for "K 2 s.a." are higher than those recorded for "E 6 s." However, the higher superheat realised in the case of "K 2 s.a." is a sufficient explanation of this characteristic. As has already been pointed out, increase in efficiency and a decrease in superheat occur together, and it might at first sight seem that the lower the superheat the higher the efficiency. This is the reverse of what would be expected, and evidently other factors which go to make up the performance of the locomotives must be taken into consideration, as influencing to a greater or less extent the efficiencies obtained. One of the principal—in fact, what may be called the direct cause of an increase in superheat—is an increase in rate of firing, and if attention is given to the marked points in the lower plot, where the figures indicate the equivalent evaporations, and also those figures giving the rates of admission, sufficient explanation is readily forthcoming as to why the higher superheats are co-related with lower locomotive efficiencies.

As a case in point, an overall efficiency of 4·5 per cent. is obtained with a high evaporation of 51,000 lb. per hour, corresponding to 230 deg. superheat, and when working at a cut-off of 50 per cent. The high evaporation and long cut-off indicate low boiler and cylinder efficiencies, hence foretelling a low locomotive efficiency. On the other hand, a low superheat of 160 deg. obtains when the evaporation is 24,000 lb., or, approximately, half the previous figure, and a short cut-off indicates a smaller demand on the boiler and greater economy in the use of the steam supplied. Here the higher boiler and cylinder efficiencies go to make up a high overall efficiency amounting to about 6·6 per cent.

In so far as the general run of these curves is concerned, whilst it seems that the average lines, as drawn in each of these diagrams, may pass through and express the mean values for the various points on the plots, yet it would appear uncertain whether these curves should be convex or concave, rather than straight, more especially as there seems no good reason to suppose that they should be different, as shown for these two locomotives.

In connection with the discussion regarding the influences which go to make up the causes for the final or locomotive efficiencies, and, more particularly, when considering the conditions of superheat obtaining when any given overall efficiency is realised, the following plot, Fig. 8, has been made.

This diagram gives, in what is believed to be an interesting manner, the efficiencies obtained from each unit, when any given degree of superheat is attained, but here, again, the observed points are so widely distributed that the true position, if any, of the curves is uncertain.

The upper part of the figure appertains to the boiler and superheater efficiency, and in the lower half of the figure the cylinder, engine, and locomotive efficiencies are separately plotted. They may each be considered briefly, and in doing so what may be called a summary of the locomotive performance is at the same time obtained.

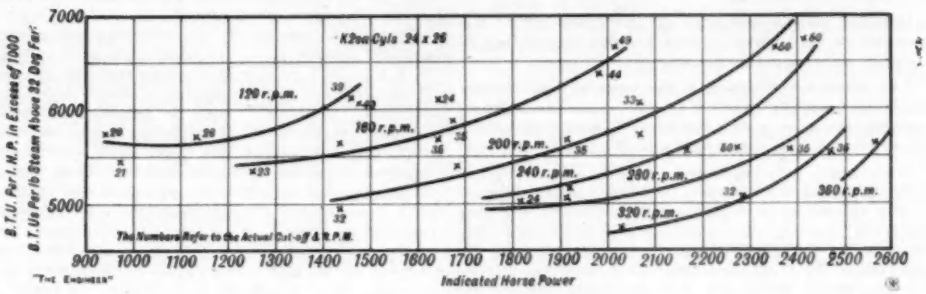

K2as Cyls 24 x 26
120 r.p.m.
160 r.p.m.
200 r.p.m.
240 r.p.m.
280 r.p.m.
320 r.p.m.
360 r.p.m.
The Numbers Refer to the Actual Cut-off & R.P.M.
B.T.U. Per I.H.P. in Excess of 1000 B.T.Us Per lb Steam Above 32 Deg Fah.
Indicated Horse Power
"THE ENGINEER"

FIG. 6

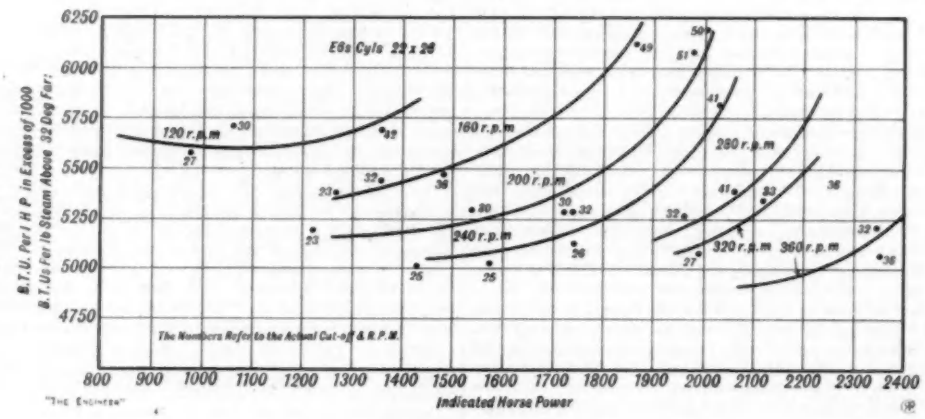

E6s Cyls 22 x 26
120 r.p.m.
160 r.p.m.
200 r.p.m.
240 r.p.m.
280 r.p.m.
320 r.p.m.
360 r.p.m.
The Numbers Refer to the Actual Cut-off & R.P.M.
B.T.U. Per I.H.P. in Excess of 1000 B.T.Us Per lb Steam Above 32 Deg Fah.
Indicated Horse Power
"THE ENGINEER"

FIG. 5

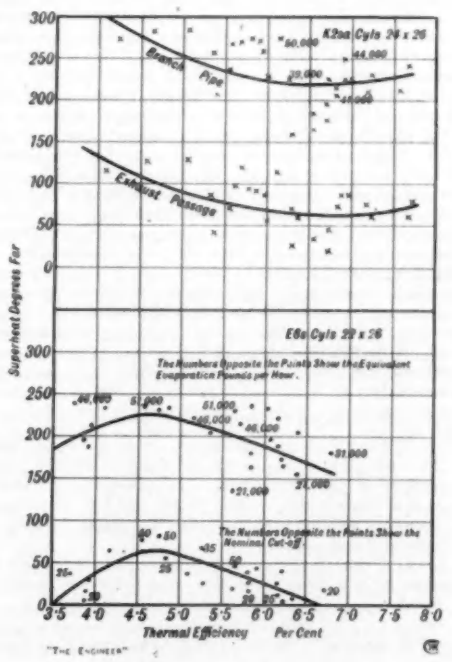

K2as Cyls 24 x 26
Branch Pipe
Exhaust Passage
E6s Cyls 22 x 26
The Numbers Opposite the Points Show the Equivalent Evaporation Pounds per Hour.
The Numbers Opposite the Points Show the Nominal Cut-off
Superheat Degrees Fah
Thermal Efficiency Per Cent
"THE ENGINEER"

FIG. 7

Boiler Efficiency.—When compared with superheat boiler efficiency falls with increasing superheat. From the study of boiler performance—THE ENGINEER, February 22nd, 1924—increasing evaporation was followed by a falling off in the water rate per pound of fuel fired, and in the consequent lowering of efficiency. At the same time, superheat followed evaporation, the greater evaporation being accompanied by greater superheat. Superheat only ceased to increase when evaporation began to fall off, owing to failure of the process of combustion.

Cylinder Efficiency.—Steam consumption per indicated horse-power governs cylinder efficiency and primarily speed—r.p.m.—and cut-off are the ruling factors. For any given speed a short cut-off gives generally the least steam rate, and hence a lower rate of evaporation and a lower rate of combustion, as a result of which the superheat falls. Conversely, lengthening the cut-off at a given speed increases the power and necessitates an increase in the steam rate, and therefore in the rate of combustion and evaporation and superheat. Hence, high superheat may be accompanied by a relatively low cylinder efficiency.

A similar reasoning is true when the rate of admission remains constant and the speed changes. Increasing the speed at a given cut-off brings about a marked decrease in the steam rate per unit of power developed.

* No. I. appeared July 5th.

The power, of course, also increases, so also does the evaporation and the degree of superheat.

Certain points on the chart have been marked to show the conditions of speed and cut-off. They indicate the effect of these factors of efficiency and substantiate the truth of the foregoing deductions.

Engine Efficiency.—Speed is probably here the prime factor because both thermal and mechanical efficiencies are largely controlled by it. From the average line as plotted, it would seem that whilst, as has been shown, speed in general lowers mechanical efficiency, yet when the cylinders are showing a high efficiency owing to high speed—r.p.m.—and early cut-off (*i.e.*, operating under ideal conditions for economical working), the adverse effect of speed on machine friction seems fully counterbalanced. This is seen when the manner in which the line denoting the mean engine efficiency rises towards that showing the average cylinder efficiencies is observed.

In further considering these two average results, the fact must not be overlooked that high superheat is usually associated with a high power output, and that as a rule high powers are obtained at the higher speeds. This consideration is sufficient to cause the decrease in the engine efficiency shown at the higher steam temperatures. It is a little remarkable that engine efficiency falls so slightly relatively to cylinder efficiency, in view of the sharp drop in machine efficiency at the higher speeds. This fact again calls attention to the marked influence speed has on steam consumption, and hence cylinder efficiency.

Locomotive Efficiency.—The efficiency of the complete locomotive—boiler, superheater and engines—is shown by the lowest line plotted in this diagram. It is evident that boiler and superheater performance has a very marked influence on the final results. The action of the boiler and superheater and the way their boiler and steam conditions have received attention in previous articles. The cylinder efficiencies are high for a non-condensing engine, and probably compare well with those of other reciprocating steam non-condensing engines, and when 1000 B.Th.U. are deducted from each pound of steam delivered to the cylinders per I.H.P. hour, the efficiency as given in Column B may, with a 25 per cent. cut-off, and at 240, 280, and 320 r.p.m. equivalent to about 55, 65, and 75 m.p.h., be approximately 50 per cent. Had 20 per cent. cut-off been used for the high-speed tests, still better results would have been shown, for at this rate of admission and for equal speeds the efficiencies on the I.H.P. basis are 11·0, 12·28, and 13·20 per cent.

For Section II. a constant speed of 240 r.p.m. was selected because a fairly regular rate of progression in the rates of cut-off was available, and it also gives results at a speed in miles per hour, at which this locomotive may often be supposed to operate, namely, 55 m.p.h.

The only figures to which any reference is required are those giving the efficiencies, as those indicating

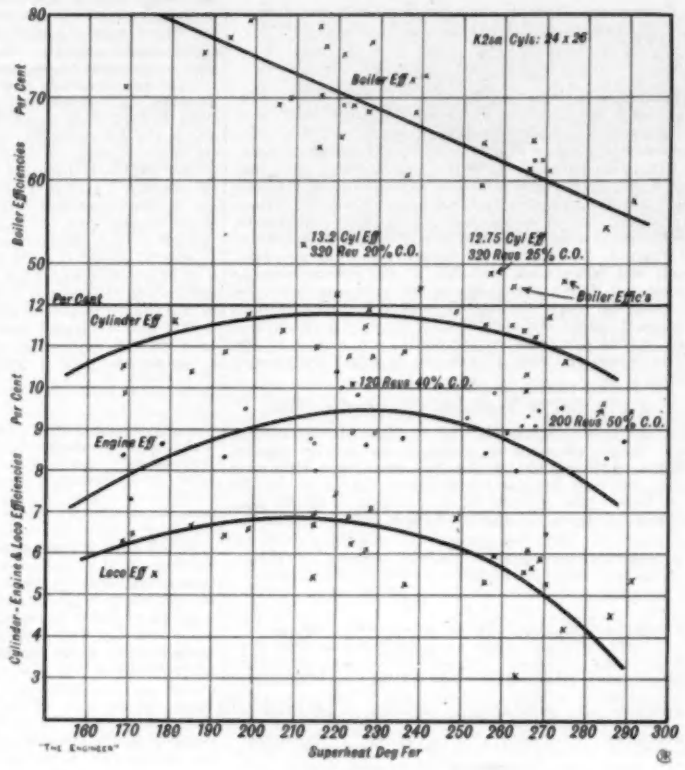


FIG. 8

TABLE II.—*Pacific Type Locomotive "K 2 s.a."; Comparison of Powers (I.H.P.), Speed (r.p.m.), Evaporations, Superheat, Water, and Coal Rates and Efficiencies.*

I. CONSTANT CUT-OFF (NOMINAL) VARYING SPEED.

Speed.	Cut-off.	I.H.P.	Equiv. evaporation boiler and superheater, lb. per hr.	Steam pressures. Boiler.	Steam pressures. Branch pipe.	Superheat, deg. Fah.	Consumptions per I.H.P. hour. Steam.	Consumptions per I.H.P. hour. Coal.	Efficiencies. Boiler and superheater.	Efficiencies. Cylinders. A.	Efficiencies. Cylinders. B.	Efficiencies. Locomotive.
120	25	972·2	24,326	205·6	198·4	169·29	18·59	2·25	76·02	10·5	46·7	6·26
160	25	1,239·8	29,596	206·0	196·4	192·88	17·76	2·09	77·87	10·9	47·4	6·51
200	25	1,687·4	38,728	204·9	193·4	226·65	16·87	2·19	69·20	11·40	47·3	6·91
240	25	1,910·0	41,728	206·0	191·7	227·43	16·11	2·11	68·16	11·92	49·2	6·00
280	25	2,104·0	44,139	204·9	189·8	240·66	15·38	1·92	71·78	12·41	50·6	7·61
320	25	2,290·3	47,199	205·9	187·3	258·10	14·92	2·30	59·14	12·75	51·0	5·96

II. CONSTANT SPEED VARYING CUT-OFFS (NOMINAL).

Speed.	Cut-off.	I.H.P.	Equiv. evaporation boiler and superheater, lb. per hr.	Steam pressures. Boiler.	Steam pressures. Branch pipe.	Superheat, deg. Fah.	Consumptions per I.H.P. hour. Steam.	Consumptions per I.H.P. hour. Coal.	Efficiencies. Boiler and superheater.	Efficiencies. Cylinders. A.	Efficiencies. Cylinders. B.	Efficiencies. Locomotive.
240	20	1,634·4	37,445	205·8	194·5	215·12	16·93	2·36	63·99	11·0	41·8	5·32
240	25	1,910·0	41,728	206·0	191·7	227·43	16·11	2·11	68·16	11·92	43·0	6·00
240	30	2,073·1	48,509	203·6	187·3	236·42	17·19	2·54	60·57	10·9	42·2	5·52
240	35	2,160·5	49,749	205·4	187·8	255·72	16·65	2·36	64·21	11·45	46·8	5·30
240	50	2,411·0	64,711	196·4	167·3	286·52	19·40	3·27	54·11	9·71	37·7	4·56

Cylinder Efficiencies.—A.: Total heat in B.Th.U. taken as the total heat in the superheated steam supplied to the engines per I.H.P. hour above 32 deg. feed temperature.

B: Total heat in B.Th.U. taken as the total heat in the superheated steam supplied to the engines per I.H.P. hour above 32 deg. feed temperature, less 1000 B.Th.U. per pound, it being assumed impossible for any locomotive to have less waste in the exhaust than 1000 B.Th.U. per pound of steam supplied above 32 deg. feed.

efficiency declines at the higher superheats, and, of course, evaporations, depress in a marked manner the mean locomotive efficiencies, as indicated by the lowest line on this graph.

With the object of drawing attention to the influence of speed and cut-off on the power and efficiencies attained, the following Table II., Efficiencies and rate of working, has been compiled. Section I. gives particulars of the power—I.H.P.—evaporations per hour, steam pressures and superheats, water and coal rates, and efficiencies for boiler, cylinder, and locomotive.

This information is given for a constant nominal rate of admission and for increasing speeds from 120 to 320 r.p.m. A cut-off of 25 per cent. was chosen rather than any other, because it happened to be the best of all rates of working; that is, the steam rate was less at 120 r.p.m. than 20 per cent.; and, further, the greatest range of speed was available by selecting a 25 per cent. cut-off. For 20 per cent. there were five different speeds; at 25 per cent. there were six available for comparison.

Speed, r.p.m.	Nominal cut-off, per cent. 20.	25.	30.	35.
	Efficiencies, I.H.P. basis.			
200	11·15	11·4	—	11·9
240	11·0	11·92	10·9	11·45
280	12·28	12·41	11·28	11·08
320	13·20	12·75	11·72	—
360	—	—	11·40	—

The tabulation above gives the comparative efficiencies at certain speeds at nominal cut-offs of 20 to 35 per cent. inclusive.

COMPARATIVE LOCOMOTIVE EFFICIENCIES.

What may be called a good general view of the comparative locomotive efficiencies is given by Fig. 1 *ante*. Here the efficiency given by each of these two locomotives has been plotted in separate panels against speed in revolutions per minute. There has also been included in each plot against each point the rate of admission obtaining during each of the tests. The higher efficiencies are obtained at the earlier cut-offs, and the mean results are for both locomotives those given at approximately 30 per cent cut-off. Here, again, attention is drawn to the influence cut-off has on efficiency. Notwithstanding the fact that mechanical efficiency was seen to be higher at the longer rates of admission than the shorter rates, especially at the lower speeds, the better cylinder and boiler performance resulting from earlier cut-offs is here seen to influence the overall results. At any usual running speed the cylinder and boiler efficiencies are higher at the shorter rates of admission, owing to the less steam rate per unit of power developed, and the lower rates of evaporation, which latter influence the boiler efficiency.

In order that a comparison may be readily seen on a locomotive efficiency basis of the performance of "K 2 s.a." and "E 6 s." the curve of mean efficiencies for the latter locomotive has been transferred to the panel—Fig. 1—showing the results given by the "Pacific" class "K 2 s.a.," and indicated by the dotted curve. The larger locomotive gives a higher efficiency. The boiler and cylinder performance of this locomotive is better than for "E 6 s.," as is also the machine efficiency for reasons already discussed.

The locomotive "K 2 s.a." shows to greater advantage at the lowest speeds, whilst at between 320 and 360 revolutions the results are equal. At 240 revolutions approximating to 55 miles per hour, the mean efficiencies are for "K 2 s.a." 6 per cent., and for "E 6 s." 5·6 per cent., and the maximum possible efficiencies are apparently about equal. The efficiencies at 50 per cent. cut-off are very low, whilst at the same rate of admission the highest machine efficiencies were realised. At 120 revolutions about 28 m.p.h., 30 to 40 per cent. cut-off gives the best results, and as the speed increases to a maximum of 360 revolutions, 84 m.p.h. shortening the cut-off to about 20 per cent. gives the best return in power for the heat expended.

For "K 2 s.a." and "E 6 s." the locomotive efficiencies would then be about 7 and 6 per cent.

This means that when both locomotives are being run under the best conditions for economy in the use of the heat units available in the fuel fired, the locomotive "K 2 s.a." gives a return in power some 16·6 per cent. greater than "E 6 s." The larger boiler and the higher power developed for a given cut-off, also the better machine-efficiency are the factors which go to give this result, which may be termed the final comparison.

B.E.S.A. SPECIFICATIONS.

IDENTIFICATION COLOURS FOR ENGINE-ROOM PIPING.

MODERN engineering practice makes large and increasing demands on the time and attention of the engine-room staff; and when one considers the ever-growing ramifications of pipes and pipe lines with which the staff has to be familiar, it is evident that a method of identification will be welcomed. Such means of identification are now provided by a specification issued by the B.E.S.A., and prepared by a Committee on which the following bodies were represented:—Admiralty, Board of Trade, Institute of Marine Engineers, Bureau Veritas, Lloyd's Register of British and Foreign Shipping, British Corporation for the Survey and Registry of Shipping, the British Marine Oil Engine Manufacturers' Association, the Liverpool Steamship Superintendent Engineers' Committee, Shipbuilding Employers' Federation, Engineers' Employers' Federation, Liverpool Steamships Owners' Association. It is believed that the B.S. Identification Colours will be of considerable value to engine-room officers when taking over a new ship or when they have to change from one ship to another.

ILLUMINATION GLASSWARE AND CARRIERS.

THE British Standard Specification No. 364, 1929, for Neck and Flange Dimensions of Illumination Glassware and Carriers, which has just been issued by the British Engineering Standards Association, ensures that the glassware and carriers shall be interchangeable. Dimensions are given for the necks and galleries for electric light and gas fittings and for the flanges and supporting rings for bowl fittings for electric light and gas. The diameter of the clearance hole in shades, reflectors or their appropriate galleries for the British Standard bayonet lampholder is also included.

These dimensions have been arrived at after due consideration of the external lug-circle diameters of gas mantles, the dimensions of electric lamps and of the British Standard bayonet lampholder, and for convenience of reference extracts from the appropriate B.S. Specifications Nos. 161 and 52, and a table giving the external lug-circle diameters for gas mantles are given in appendices.

Copies of these specificatione can be obtained from the Publications Department, British Engineering Standards Association, 28, Victoria-street, S.W. 1, price 2s. 2d. post free.

ACCORDING to Sir Edmund Davis, Rhodesia can supply all the Empire's requirements in the way of copper. It is proposed to expend £3,500,000 on plant for the four principal copper mines of Northern Rhodesia.

Lloyd's Register Year Book.

THE new edition of Lloyd's Register Book contains, as usual, complete particulars of all the sea-going vessels of the world, of 100 tons and upwards, and, in addition, of the steel and iron vessels trading on the Great Lakes of North America. It includes a full record of about 32,800 steamers, motor ships and sailing vessels, and comprises also many lists of great practical value to the shipping community, such as:—Signal letters assigned to all sea-going vessels; shipbuilders and marine engineers in all countries; detailed particulars of dry and wet docks, ports, harbours, &c., in each country; telegraphic and postal addresses of about 20,000 firms connected with shipping in all parts of the world; particulars of the speed of merchant vessels capable of 12 knots and upwards, and of deadweight and cubic capacities of cargo steamers and motor ships; lists of bulk oil carriers; lists of shipowners and managers all over the world, with the names and tonnages of their respective vessels, &c.

The following summary of some of the results which are to be obtained by an analysis of these tables, and by a comparison with similar tables issued by Lloyd's Register in previous years, will be found of interest.

CLASSIFICATION OF VESSELS.

The number and tonnage of existing vessels recorded in the new edition of the Register Book—including over 760,000 tons of new ships afloat in course of classification—which are now or have been classed by the Society is 15,486 of 42,116,071 tons. Practically all these vessels were built under the inspection of the Surveyors of Lloyd's Register. It may here be explained that the figures regarding tonnage of vessels throughout this article refer to gross tonnage.

That this appreciation is world-wide is well shown by the fact that of the tonnage actually holding the Society's class, 46¼ per cent. is registered in Great Britain and Ireland and 53¼ per cent. in other countries.

World Tonnage in Existence at June, 1929, and June, 1928.

Where owned.	1929. Steamers and motor ships.	1929. Sailing vessels.	1929. Total.	1928. Steamers and motor ships.	1928. Sailing vessels.	1928. Total.
Great Britain and Ireland	20,046,270	120,061	20,166,331	19,754,001	121,349	19,875,350
Other countries	46,361,123	1,546,858	47,907,981	45,405,412	1,673,897	47,079,309
Total	66,407,393	1,666,919	68,074,312	65,159,413	1,795,246	66,954,659

The above table shows that during the last twelve months there was an increase in the steam and motor tonnage owned in the world of 1,247,980 tons, and a decrease in the sailing tonnage of 128,327 tons, making a total world net increase of 1,119,653 tons. The net increase from June, 1927, to June, 1928, was 1,761,749 tons. The countries showing the largest increases for the last twelve months are:—Germany—315,301 tons—Great Britain and Ireland—290,981 tons—and Norway—256,286 tons. Amongst the principal maritime countries, only two show an appreciable decrease, viz.:—The United States—151,380 tons—and Italy—144,157 tons. In both cases this is due to the tonnage broken up since June, 1928, having been much higher than during the previous year.

COMPARISON OF STEAM AND MOTOR TONNAGE AT JUNE, 1914, AND JUNE, 1929.

Gross tonnage of steamers and motor ships owned in the world as recorded in Lloyd's Register Book for the years 1914 and 1929.

Country.	1914.	1929.	Difference.
Great Britain and Ireland	18,892,000	20,046,000	+ 1,154,000
British Dominions	1,632,000	2,795,000	+ 1,163,000
Denmark	770,000	1,033,000	+ 263,000
France	1,922,000	3,303,000	+ 1,381,000
Germany	5,135,000	4,058,000	− 1,077,000
Greece	821,000	1,267,000	+ 446,000
Holland	1,472,000	2,932,000	+ 1,460,000
Italy	1,430,000	3,215,000	+ 1,785,000
Japan	1,708,000	4,187,000	+ 2,479,000
Norway	1,957,000	3,218,000	+ 1,261,000
Spain	884,000	1,136,000	+ 252,000
Sweden	1,015,000	1,480,000	+ 465,000
United States (sea)	2,027,000	11,036,000	+ 9,009,000
United States (Lakes)	2,260,000	2,451,000	+ 191,000
Other countries	3,479,000	4,251,000	+ 772,000
Total	45,404,000	66,408,000	+21,004,000

The net addition during the fifteen years 1914–1929 amounted to 21 million tons, equal to 46½ per cent. of the pre-war tonnage. It may be of interest to state that, during the fifteen years 1899–1914, the net increase was 24,526,000 tons, equal to over 117 per cent. of the steam tonnage in existence in 1899. If a shorter period be taken for comparison it will be seen that while during the five years 1909–1914 the world increase—8,931,000 tons—amounted to 24½ per cent. of the tonnage owned in 1909 during the five years, June, 1924, to June, 1929, the increase—4,893,000 tons—amounted to less than 8 per cent. of the world tonnage at June, 1924, the average yearly increase being only 1·6 per cent. As compared with 1914, the largest increases took place in the United States—9 million tons—and in Japan—2·5 million tons. Increases of over a million tons also occurred in six other cases, namely, Italy—1,785,000 tons—Holland—1,460,000 tons—France—1,381,000 tons—Norway—1,261,000 tons—British Dominions—1,163,000 tons—and Great Britain and Ireland—1,154,000 tons. The increase of tonnage belonging to Great Britain and Ireland represents only 6·1 per cent. of the tonnage owned in 1914, whereas the increase of tonnage owned abroad represents nearly 75 per cent. of the pre-war tonnage. Notwithstanding an increase of 1,548,000 tons since June, 1923, Germany still shows a decrease of 1,077,000 tons as compared with June, 1914.

In 1914 there was owned in Great Britain and Ireland 41·6 per cent. of the world's steam and motor tonnage, but owing to the great increase which has taken place since 1914 in the tonnage owned abroad, the percentage of 41·6 has now been reduced to 30·2. Similar percentages for the two years respecting the next seven leading countries are:—

	1914.	1929.
United States (sea)	4·5	16·6
Japan	3·8	6·3
Germany	11·3	6·1
France	4·2	4·97
Norway	4·3	4·85
Italy	3·1	4·84
Holland	3·2	4·4

SAILING TONNAGE.

The reduction in sailing tonnage since pre-war times, say, June, 1914, amounts to about 2,310,000 tons gross. The present percentage of sailing vessels to the world's total tonnage is under 2·5. Of the world's sailing tonnage, 890,219 tons—equal to 53·4 per cent. of the total—are now owned in the United States, and the other countries which still have an appreciable amount of sailing tonnage are:—Great Britain and Ireland, 120,000 tons; Canada, 95,000 tons; France, 76,000 tons; Italy, 69,000 tons; and Finland, 67,000 tons. If barges, which are generally towed, and other craft included in the sailing tonnage because not fitted with engines for self-propulsion, be excluded, the world tonnage of real sailing vessels only amounts to about 906,000 tons, of which 333,000 tons—equal to 36¾ per cent. of the total—are owned in the United States, and only 17,800 tons in Great Britain and Ireland.

SIZE AND AGE OF STEAMERS AND MOTOR SHIPS.

A considerable increase has taken place in recent years in the number of sea-going steamers and motor ships of 4000 tons each and above. In 1914 there were 3608 such vessels, and now the number reaches 6335, of which 425 are of 10,000 tons and above, including 59 of 20,000 tons each and upwards. Of the 425 vessels 237 are under the British flag. It may be noted that just under one half of the total number of steamers and motor ships in existence are of less than 1000 tons each.

One of the tables shows that of the motor ships now in existence there are 744 of 4000 tons and above. One hundred and twelve of them are of between 8000 and 10,000 tons, and sixty are of 10,000 tons and upwards. From another table, in which steamers and motor ships are classified according to their size and age, we notice that there are 3167 vessels less than five years old with a tonnage representing 15·6 per cent. of the total steam and motor tonnage. Vessels of twenty-five years and over amount to 8033, but their tonnage is slightly less than that of the 3167 newer vessels. Of the vessels built in 1904 or before, nearly 63 per cent. are of less than 1000 tons each and the average size of the others is 2891 tons, while of the vessels built during the last five years only 37·3 per cent. are of less than 1000 tons each and the average of the others reaches 4997 tons. Of the 991 vessels of 8000 tons and upwards now in existence, 259 have been built during the last five years.

Of the tonnage owned in Great Britain and Ireland 22·5 per cent. is less than five years old. The only countries which have a larger proportion of new tonnage—less than five years old—are Norway with 27·2 per cent. and Germany with 24 per cent. France, Japan and Spain have less than 9 per cent. Of the United States sea-going vessels only 3½ per cent. are less than five years old, but for those trading on the Great Lakes the percentage rises to 6·6. Of the principal maritime countries Greece has the least proportion of new vessels, only 2·4 per cent. of the total tonnage being under five years old. Of the tonnage registered in Great Britain and Ireland 83½ per cent. is under twenty years old, while the percentage for the tonnage owned abroad is only 71. The group of vessels with the largest aggregate of tonnage is that of between 4000 and 6000 tons each, amounting to 19,183,599 tons, equal to 28·9 per cent. of the world's total steam and motor tonnage. The big liners, say, those of 15,000 tons each and upwards, represent only 4¾ per cent. of the total tonnage; it may be added, however, that 55·4 per cent. of the tonnage of these liners is owned in Great Britain and Ireland.

TYPE OF MACHINERY.

From the table showing the type of machinery used for the propulsion of vessels can be realised the great development which has taken place in the use of steam turbine engines and of internal combustion engines. There are now 1456 steamers of over 10 million tons fitted with turbine engines or a combination of steam turbines and reciprocating engines, and 3246 vessels—including auxiliary vessels—of 6,628,102 tons, fitted with internal combustion engines, as compared with 730,000 tons and 220,000 tons respectively in 1914. It may be stated that while during the last twelve months there was an increase of 1,196,000 tons in the tonnage of motor ships and of 363,000 tons in tonnage of vessels fitted with steam turbines, the tonnage of steamers fitted solely with reciprocating steam engines has actually decreased by 311,000 tons. The increase in the motor ship tonnage at June, 1929, as compared with June, 1924, amounted to 4,652,000 tons.

An interesting feature is the comparatively large proportion of motor tonnage included in the merchant navies of some countries. While the total motor tonnage now owned in the world amounts only to 11·1 per cent. of the steam tonnage—in Great Britain and Ireland 10·6 per cent.—such percentage is much higher in the Scandinavian countries, viz.:—Norway, 42·7; Denmark, 42·4; and Sweden, 38·2. Amongst the principal maritime countries, Italy, Germany and Holland have the next highest proportions, viz., 17·2, 17, and 15·2 per cent. respectively. Of the principal countries the following have the lowest percentages of motor tonnage:—Spain, 7·4; Japan, 5·8; United States, 4·3; France, 2·1; and Greece, 0·45.

An analysis of the type of machinery now employed also shows that there are recorded in Lloyd's Register Book 93 vessels, with a total tonnage of 839,082 tons—included in the above-mentioned totals for turbine vessels—which are fitted with a combination of steam turbines and reciprocating engines. Another interesting particular is that in the case of 60 vessels with a tonnage of 259,467 tons, a comparatively new system of propulsion has been adopted, viz., electric motors connected to the screw shaft, these motors being supplied with current from generators, which are driven either by steam turbines or oil engines. Of these vessels, 47 of 197,025 tons are owned in the United States, including 3 vessels of over 20,000 tons each. Of the 29,612 steamers and motor ships of 100 tons gross and upwards recorded in the Register Book, 3561 are twin-screw vessels and 124 have triple or quadruple screws. We note, too, that there are recorded in the new Register Book 3787 steamers of 19,420,895 tons fitted for burning oil fuel, of which 829 of 5,413,962 tons are registered in Great Britain and Ireland and 1793 of 8,799,433 tons are registered in the United States of America.

The above figures enable a comparison to be made between the respective employment of coal and oil fuel at the present time as compared with 1914.

	1914 % of total gross tonnage.	1929 % of total gross tonnage.
Sailing vessels and sea-going barges	8·06	2·45
Oil, &c., in internal combustion engines	0·45	9·73
Oil fuel for boilers	2·65	28·53
Coal	88·84	59·29
	100·00	100·00

It will thus be seen that less than 59½ per cent. of the tonnage of the merchant marine now depends entirely upon coal, while in 1914 the percentage was nearly 89. It must, of course, be understood that oil is not always used in steamers fitted for burning oil fuel, as such installations can readily be replaced by coal-burning fittings should it happen that oil be unobtainable or its price render it unprofitable.

TYPE OF VESSELS.

The tables showing the total tonnage of certain types of vessels, give information that is useful in estimating the tonnage available for general cargo and passenger purposes. The tonnage of the 1236 tankers, of 1000 tons gross and upwards, amounts to 6,987,922 tons; 388 of 2,165,208 tons are registered in Great Britain and Ireland, and 381 of 2,374,358 tons are registered in the United States. In addition, there are 83,093 tons of tankers of less than 1000 tons each. The tonnage of trawlers and other fishing vessels and whalers amounts to 910,404 tons. An analysis of the vessels recorded in the Register Book shows that 362,841 tons represent tugs and salvage vessels, and 791,679 tons steam barges, dredgers and similar craft, ferries, river vessels and vessels owned by municipal corporations or harbour authorities. Although few paddle vessels are now built, the total tonnage of such vessels in existence and recorded in the Register Book still amounts to 334,763 tons. Without taking into account size, age or material, there are nearly 9½ million tons of vessels which are not used for general cargo and passenger purposes.

TONNAGE OF THE LARGER OCEAN-GOING STEAMERS AND MOTOR SHIPS AVAILABLE FOR GENERAL CARGO AND PASSENGER PURPOSES.

If all vessels of the types mentioned in the preceding paragraph be omitted, and disregarding also (*a*) vessels trading on the Great Lakes of North America, (*b*) wood vessels, (*c*) vessels of less than 5000 tons gross, and (*d*) vessels over twenty-five years old—with the exception of a few which although up to thirty years old are still capable of a high speed—and presumably of less efficiency than more modern vessels, the following figures are obtained which indicate the relative position of the principal maritime countries of the world, as regards the larger ocean-going vessels available for general cargo and passenger purposes:—

Countries.	Total steam and motor tonnage in Table I. Tonnage owned.	Percentage of world total.	Ocean-going tonnage as defined above. Tonnage owned.	Percentage of world total.
Great Britain and Ireland	20,046,270	30·19	10,139,173	38·42
United States	13,591,803	20·47	5,489,095	20·80
Germany	4,057,657	6·11	2,083,739	7·89
Holland	2,932,420	4·42	1,618,373	6·13
Japan	4,186,652	6·30	1,596,653	6·05
Italy	3,215,327	4·84	1,497,579	5·67
France	3,302,684	4·97	1,472,379	5·58
Norway	3,217,795	4·84	497,243	1·88
Other countries	11,856,785	17·86	1,999,048	7·58
World total	66,407,393	100·00	26,393,282	100·00

This table shows the relatively high efficiency of the merchant fleet of Great Britain and Ireland, which, while comprising 30·19 per cent. of the world tonnage as recorded in the Register Book, has actually 38·42 per cent. of the more efficient ocean-going tonnage available for general cargo and passenger purposes. Considerable differences are also shown as regards three other countries, viz., Holland and Germany—which from percentages of 4·42 and 6·11 respectively of the total tonnage, rise to 6·13 and 7·89 per cent. of the larger ocean-going tonnage, and, on the other hand, Norway, which from 4·84 per cent. is reduced to 1·88 per cent.

TONNAGE OWNED IN THE WORLD AT VARIOUS DATES.

Another table, which is useful for the purpose of ascer-

taining the development of the merchant navies during the last thirty-five years, shows for each of the years 1895–1929 the number and the gross tonnage of the steamers and motor ships, and of the sailing vessels, owned in the world distinguishing also the principal maritime countries. From this table some remarkable variations can be observed. In 1895 the gross tonnage of steamers amounted to 16,888,000 tons, and the gross tonnage of sailing vessels to about 8,850,000 tons. The steam and motor tonnage has increased by over 49¼ million tons, while the sailing tonnage has decreased by 7,183,000 tons. Apart from the enormous increase which has taken place in the United States sea-going steam tonnage and the decrease in the German tonnage, both due to the war, the following are the most noticeable changes during this period of thirty-five years :—

(*a*) The sail tonnage registered in Great Britain and Ireland and in Norway, which in 1895 amounted to about 2,614,000 tons gross and 1,308,000 tons gross respectively, is now reduced to 120,061 and 6698 tons respectively.

(*b*) The increase in the steam and motor tonnage owned in Great Britain and Ireland amounts to 10,350,000 tons. The most remarkable development has taken place in Japan, the steam tonnage of which country now reaches a figure equal to nearly fifteen times the total owned in 1895. The present steam tonnages of Greece, Holland and Italy are over nine times, that of Norway over seven times, and that of Sweden over six times as great as in 1895.

Tonnage Lost and Broken Up.

One of the tables shows the tonnage of steamers and motor ships lost and broken up each year from 1905 onwards. As regards losses one point deserves special mention, and that is the considerable decrease in the percentage lost during the last five years as compared with other quinquennial periods in pre-war times. The average yearly percentage of steam tonnage lost during the years 1924–28 only amounted to 0·70 per cent., while, for instance, during the years 1909–13 the average was nearly 1·17 per cent. These figures may, of course, to some extent be influenced by the large amount of tonnage laid up during recent times.

The figures for steamers broken up vary to an enormous extent from year to year. During the period 1905–1909 the minimum was 120,003 tons, and the maximum 251,900 tons; during 1910–1914 the variation was from 87,737 tons to 245,891 tons. During the years 1915–1920 practically no tonnage was broken up, the yearly average only amounting to 10,000 tons. Quite different conditions are shown for recent years. During 1921 the tonnage broken up amounted to 77,500 tons; it increased to 315,000 tons for 1922; to 963,000 tons for 1923; and for the year 1924 the total reached 1,174,000 tons. The tonnage broken up during 1925 amounted to 653,000 tons, and to 799,000 tons during 1926, but during the year 1927 the vessels broken up only amounted to 403,000 tons. The figures for 1928 show an increase, having reached 736,000 tons. It is obvious that the tonnage broken up has an important bearing on the shipping position, and that if the amount of tonnage thus disposed of had been continued for some years on the high level reached in 1923 and 1924, it would have gone a long way towards solving the problems that confront shipowners. Of the total tonnage broken up during the six years 1923–1928—4,727,000 tons—1,118,000 tons were registered in Great Britain and Ireland, 1,579,000 tons in the United States, 585,000 tons in Italy, and 506,000 tons in France.

Although the average percentage of tonnage broken up during this period to the total tonnage owned is less for Great Britain and Ireland than for the tonnage owned abroad, this difference is easily accounted for by the fact that a considerable number of the older vessels are purchased from Great Britain and Ireland by other countries, the result being that while of the tonnage now owned in Great Britain and Ireland less than 17 per cent. consists of vessels of twenty years of age and above, the tonnage owned abroad comprises 29 per cent. of vessels twenty years old and over.

The Cornish Riviera Express.

It is just twenty-five years since the 10.30 ex Paddington non-stop to Plymouth was established as a special train—the Cornish Riviera Express. But events, historical in the annals of British railways, had preceded and led up to that step. On July 14th, 1903, the "City of Bath"—a 4–4–0—was given five coaches, of which the centre one held a Royal party, including our present King and Queen, and ran from Paddington straight through to Plymouth without stopping. She did the journey in 3 hours 53 minutes and 35 seconds, and when the speed became known, there was some public excitement and some protest. As a matter of fact, the average speed—the route was *viâ* Bristol in those days, 246 miles—was 63·4 m.p.h., but from London to Exeter the average attained was 67·3 m.p.h. Nearly a year later a sister engine, "City of Truro," made a run from Plymouth to Paddington so remarkable that for nearly eighteen years it was deemed prudent to suppress the facts. Our famous contributor for many years, Mr. Rous Martin, took the times for the railway, and they may be found with his comments in our issue of November 17th, 1922. The journey was made in 3 hours 47 minutes and at places a speed of 100 m.p.h. was touched.

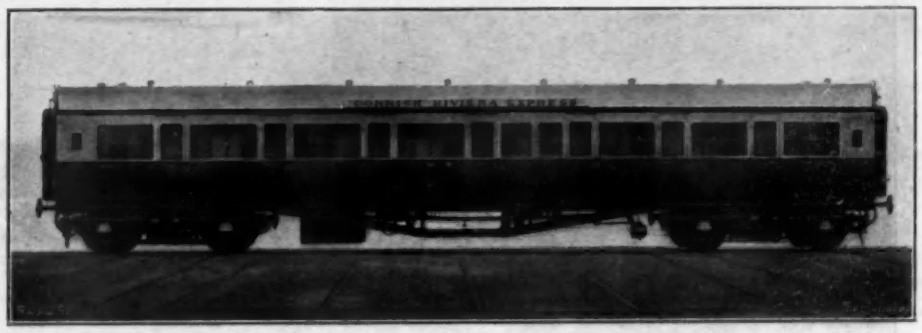
Out of these experiences sprang the Cornish Riviera Express, which first ran by that name on July 1st, 1904. Exactly two years later Bristol was avoided by the opening of the Castle Cary route, and the distance was reduced by 19 miles, the time then becoming 4 hours and 10 minutes from Paddington to Plymouth, and 6 hours 40 minutes to Penzance. The departure time from London was advanced to 10.30, which it has remained ever since.

To celebrate this event the Great Western opened its summer service on Monday last with a train composed of entirely new rolling stock, one coach of which is illustrated above. The whole train was made at Swindon. The coaches are 60ft. long and 9ft. 7in. wide, and are equipped in every respect in the best style of railway furnishing. As far as possible they are fireproofed throughout. The Royal train of 1903 had but five coaches; the train of to-day has no less than thirteen—an extra one was put on at Paddington on Monday to ease the fears of the superstitious!—and carries, seated, 428 passengers, of whom 119 can dine at one time. The weight is 449 tons at the start, but two coaches are slipped at Westbury for Weymouth, one remains at Plymouth, one at Truro for Falmouth, and one at St. Erth for St. Ives, leaving eight to complete the journey to Penzance. On the return journey the slip at Westbury is omitted, and the train is composed of eleven coaches from Plymouth onwards. The two coaches slipped at Westbury return on another train.

One feature to which attention must be called is the use of Vita glass in the carriage windows. Whether this remarkable glass is suitable for the purpose remains to be proved. On a blazing day it may pass too much of the sun's rays for the comfort of those who are near the windows.

The double journey on Monday and Tuesday last was made with locomotive "King George V.," No. 6000 in the harness as far as Plymouth, the remainder of the journey being made by one of the "Castles." It was so perfect as to be quite uneventful, Mr. Collet's famous engine always having plenty in hand. On the down run both Plymouth and Penzance were reached before time, and on the up journey Paddington was entered six minutes early. From Westbury to Taunton, 47½ miles, took 45 minutes, and from Westbury to Exeter, 78¼ miles, 76 minutes. Patney was passed at 81 m.p.h. and Taunton at 82 m.p.h. The running was very easy and comfortable all the way. The engine is certainly capable of a greater effort than she is called upon to make, but we venture to commend the Great Western Railway on adopting a timing which allows sufficient margin to ensure punctuality.

G.W.R.—NEW PASSENGER COACH



SIXTY YEARS AGO.

The early operation of the electric telegraph in this country was placed by Parliament in the hands of several private companies. The manner in which these companies conducted their services gave rise to many complaints. In 1865 only about 1000 places in the kingdom were supplied with telegraphic communication, out of 10,685 provided with postal communication. The charges were excessive, and were levied on a complex differential scale, and the messages were frequently not only seriously delayed, but badly mutilated in transmission. As early as 1854 the transfer of the telegraph services from company to State ownership was advocated, but the proposal had no force behind it until the Edinburgh Chamber of Commerce in 1865 took steps which developed into a public demand for the transfer. The Government moved in the matter in 1868 and 1869, and under the powers conferred by Acts passed in those years the bulk of the telegraph services in the kingdom passed into the care and possession of the Post Office in January, 1870. In our issue of July 9th, 1869, we recorded the proceedings attending the introduction and first reading of the Bill of 1869 in the House of Commons. Apart from giving the Post Office the exclusive privilege of transmitting messages by electric telegraph—a privilege withheld from it in the Act of the previous year—the Act of 1869 was mainly concerned with the financial side of the transfer. The basis of the transaction was to be the payment to the telegraph companies of purchase money calculated at twenty years' profit to June 20th, 1869. The sum represented amounted to a total of £5,715,047. In addition, it was estimated that £700,000 would be required to purchase the interests of those railway companies which carried on telegraph business and that £300,000 would be required to cover incidental expenses connected with the transfer. The gross revenue which the Government expected to earn when the telegraphs were transferred to the Post Office was £673,838. The estimated expenditure was £359,484, so that the anticipated balance was £314,354. The Bill of 1869 authorised the Treasury to raise a sum not exceeding £7,000,000 for the carrying out of the transaction. An additional million pounds was authorised in 1871 in connection with the extension of the telegraph system to the Channel Islands, and the Isle of Man, but in the end the sum which had to be raised was over £10,000,000. The estimated revenue and expenditure figures were fairly closely realised during the first year of the Post Office's operation of the system, the net revenue from March, 1870, to March, 1871, being £303,457, but during the immediately succeeding years the profits fluctuated through a wide range and failed to show the expansion which had been anticipated. In 1875 the net revenue fell to £59,732. By 1881 it had risen to £368,815, but in 1884 it fell to £51,393. To-day the Post Office telegraph system is operated at a clear loss, the annual deficit being about £1,500,000.

South African Engineering Notes.

Postmasburg Manganese.

In a report on the Postmasburg manganese deposits prepared as the result of a geological survey carried out by Dr. L. T. Mel, it is stated that: "The tonnage of manganese ore available is enormous, even if the inferior grades be excluded. Apparently the greater bulk of this is made up of ore in which the manganese content ranges between 40 and 50 per cent. There are also large reserves of very high-grade ore carrying more than 50 per cent. metallic manganese. The average iron content over the entire fields would probably exceed 7 per cent., but it has been proved that there are extensive deposits yielding ferro-grade ore with less than 7 per cent. iron. The ore possesses superior physical qualities which prevent any crumbling or production of fines during mining operations, ensure very little loss in transit, and reduce loss from flue dust to a minimum. The ore is also eminently suitable for storage, as there is no apparent tendency for it to disintegrate. . . . The available tonnage of manganese is enormous, and must run into many millions of tons. Much of this is made up of ore running between 40 to 50 per cent. of manganese. But in addition there are also large reserves, the tonnage of which runs probably into seven or eight figures, of high-grade ore carrying more than 50 per cent. metallic manganese and with iron not exceeding 7 per cent.

"Under the circumstances and because of the large reserves of ore available at or close to the surface, open cast workings or quarrying will be all that is necessary for some time to come. By this method many thousand tons of manganese ore can be extracted per month for a period of many years. . . . The large tonnage of high-grade ore available, combined with a mode of occurrence and topography that lend themselves readily to open cast mining or mining at shallow depths, are important factors in favour of low mining costs. In this connection the superior physical quality of the ore, which practically prevents any crumbling, and the production of fines during mining operations, places the Postmasburg Fields ahead of all commercial deposits on record from anywhere else in the world.

"Taking everything into consideration—and the burning transport question having been solved by the agreement with the Government to bring a railway to Postmasburg—it is evident that in the manganese deposits of the Postmasburg region, South Africa has a valuable asset which promises to develop into an important industry taking the form not only of a manganese export trade but possibly also of a local manufacture of ferro-alloys."

The report further states that "the manganese ore of this region is chiefly associated with hematite iron ore, which in bulk is comparable to and may even surpass that of the manganese ores."

Inyaminga Petroleum.

For some two years past Inyaminga Petroleum, Ltd., has been busily engaged in endeavouring to strike oil at Inyaminga, in Portuguese East Africa. It has had the country gone over carefully by geologists of high standing, and all have declared that the geological conditions are right, and that there is no doubt that the oil is there, and will be struck before long. Four bore-holes have been put down in turn, and each has provided valuable information. Explorations have also been done by the electrical and afterwards by the geo-physical methods, and all have confirmed the geologists' opinions.

At the meeting of shareholders at Johannesburg on April 24th, a report from the field geologist, Mr. van Soelen, of which the following is an extract, was read: "Geological features are favourable for the occurrence of oil, since my detailed survey has proved the existence of an anticlinal fold or enlongated dome in the region where drilling operations are in progress at present. It is to be expected that under the cretaceous beds in which the bore-holes have been brought down at present, lower cretaceous marine formations and/or jurassic beds will be encountered, carrying oil. The most favourable point for a drill hole will be near the top of the elongated dome, which point is about 2 miles south-west of the present bore-hole. As the result of the bore-hole No. 4, we know that the thickness of the upper cretaceous sandstones is not less than 2500ft., and therefore the mother rock of oil must be expected to be found at a depth exceeding this thickness, but probably not far over 3000ft." Commenting on the position, the chairman of the company said: "We feel perfectly certain to-day, on the advice of our experts and the result of our work, that we are going to strike oil, and we are on the right formation, and the oil is there. We have already had proof of it, indications of it, and we feel—all the board feels absolutely confident that we are going to strike the oil. We won't miss it."

SARDA IRRIGATION SCHEME—SYPHON UNDER RIVER JAGBURA

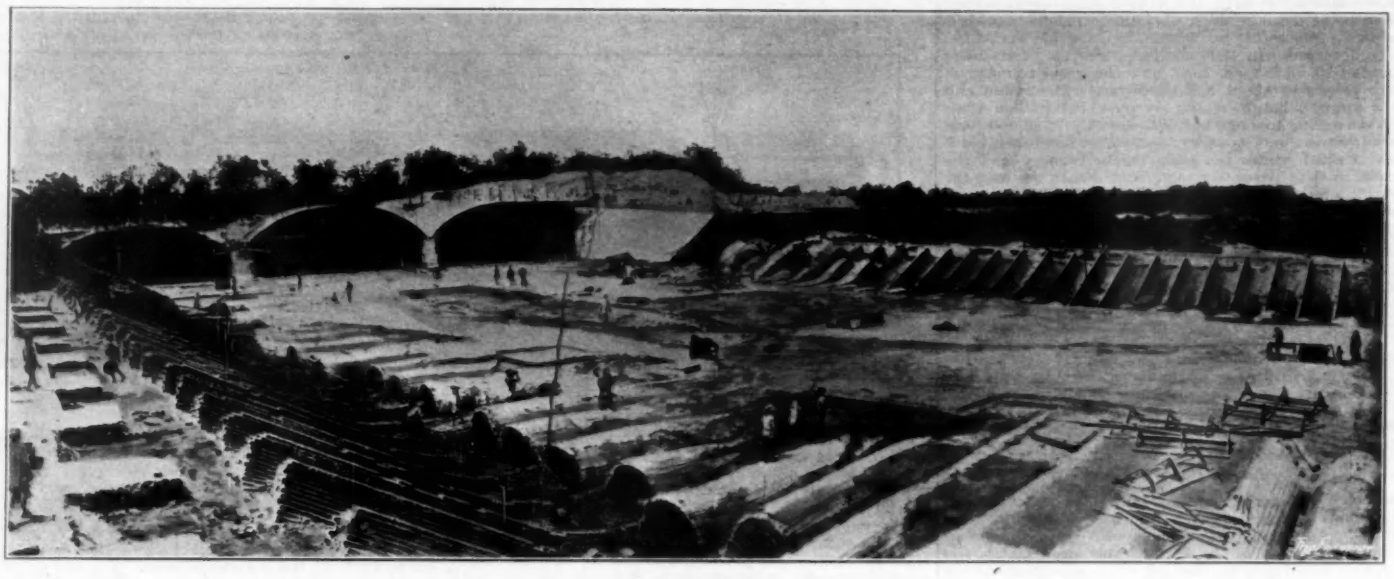


FIG. 1

Sluice Gates for the Sarda River Irrigation Scheme.

As we announced at the time, the important Sarda River Irrigation scheme, which had been in course of being carried out for a number of years past, was formally put into service in December last by Sir Malcolm Hailey, the Governor of the United Provinces of Northern India. This undertaking forms one of the largest irrigation systems in India, commanding, as it does, an area of upwards of 7,000,000 acres, or approximately twice the size of Yorkshire. Of that total it is anticipated that something like 1,400,000 acres will be brought under cultivation in dry years. The river, which has been dammed for the purpose, is known, at the site of the barrage as the Sarda, but lower down it is known as the Chauka. It rises in the Himalayas nearly due north of Lucknow, and flows in a south-easterly direction, eventually discharging into the river Gogra, which, in turn, makes confluence with the Ganges near Chapra. The Sarda is a river which is subjected to violent fluctuations in flow. Floods as heavy as over half a million cusecs have been experienced, though the natural discharge may fall to less than one hundredth part of that volume.

To impound the water to the height desired for irrigation purposes a barrage was built across the River at Banbassa, just where the foothills begin to rise from the plains. This barrage, two views of which are given on page 40, has a total length of 1965ft., and it is furnished with thirty-four Ashford patented gates, made by Glenfield and Kennedy, Ltd., of Kilmarnock. Each of the gates has a span of 50ft., and each is constructed of mild steel horizontal bow-string girders, and covered on the upstream side with heavy skin plating. Thirty of them have a depth of 11ft., while the remaining four which come next to, and, of course, downstream of the canal intake, are 13ft. deep. The reason for having these four gates deeper than the others is that a scouring action may be set up in front of the canal intake so that accumulations of shingle, which constantly tends to be deposited there, may be avoided. Long training walls are built as extensions to the piers, both up and downstream, at intervals of four or five bays, to control the flow of the river and to prevent the formation of damaging cross currents and the building up of shoals and islands which, without some precaution of the kind, might readily form.

The superstructure of the gates is composed entirely of steel, and there is a steel girder bridge on the downstream side of the piers to provide regular communication between the United Provinces and Nepal. Trains of free rollers are suspended between the gate end ports and their corresponding paths, and are housed within the gate grooves. These roller trains travel only half the distance travelled by the gates, and are for the purpose of eliminating—which, we understand, they do almost entirely—the frictional resistance encountered during operation. Protection is afforded to those rollers which are situated below the gates, when the latter are in the raised position, by a special design of gate groove housing which, so we are informed, effectively prevents vibration and damage of the rollers caused by the high velocity of the flow of water.

FIG. 2—THE HARDOI AND KHERI BRANCHES' BIFURCATION

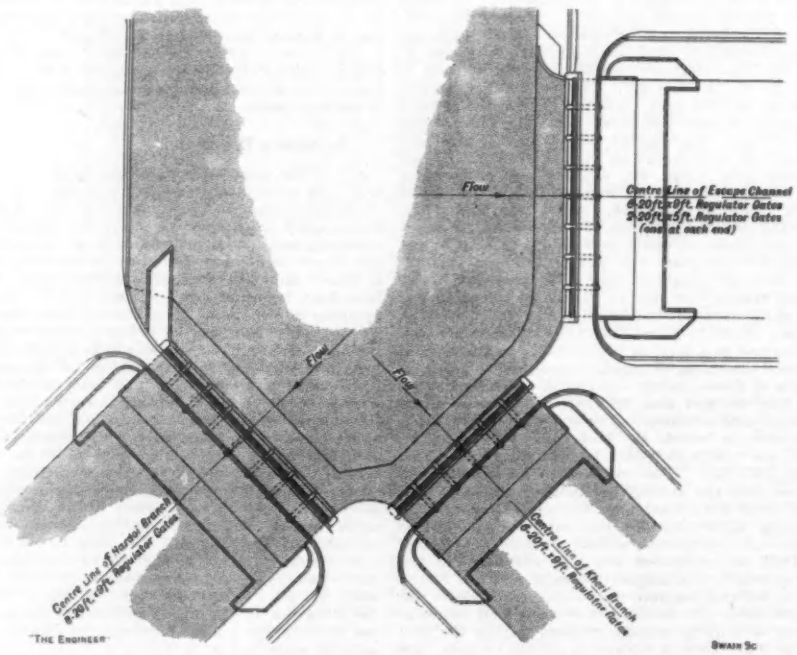


FIG. 3—PLAN OF HARDOI AND KHERI BRANCHES' BIFURCATION

Each set of operating gear consists of a hand-worked worm-geared headstock, which is totally enclosed and embodies an oil bath and anti-friction ball thrust washers for the gearing, from which the power is transmitted through a horizontal shaft to two machine-scrolled winding drums. On these drums are wound the ropes for the gate and for the counterbalance weight, the latter being suspended in a bight in the rope so as to reduce its travel to one half of that of the gate. For the thirty shallower gates the gear is of the rapid, semi-automatic self-lifting type for quick operation in times of flood, but the four deep abutment scour sluices are designed for opening by hand.

The main canal which takes off immediately upstream of the barrage is 350ft. wide at the bottom at the start, and 27 miles long. Its depth is just over 8ft. The intake is controlled by sixteen sets of regulator sluice gates, each of 20ft. span and 6ft. 4in. deep. The gates are of the fixed roller type, and are designed to open either upwards or downwards, so that the top water may be drawn off, whatever the height of the impounded level, with a minimum of gate movement. The operating gear consists of a series of totally-enclosed worm-geared headstocks driving horizontal shafts to which are keyed sprocket wheels. Link chains, directly connected to the gates and counterbalance weights, hang over these sprockets and communicate the operating movement to the gates.

About 8½ miles down the main canal a syphon had to be constructed to convey the water under the river Jagbura. It consists of a series of twenty-seven reinforced concrete pipes, 6ft. in diameter, built under the river bed—see Fig. 1. The flow in the canal is 5000 cubic feet per second—which is about the normal flow of the River Thames—so that the velocity of the flow of water through the syphon pipes is between 6½ft. and 7ft. per second. At a point some 14 miles further along the canal there is an escape channel, and, closely adjoining, there is a bifurcation of the canal, one arm of the fork feeding the Hardoi Branch and the other the Kheri Branch of the irrigation system. The entrance to each of these canal systems is controlled by a series of "Glenfield" sluice gates. The arrangements at this point are illustrated in the accompanying half-tone engraving and drawing—Figs. 2 and 3. The escape channel is furnished with six regulator gates, each 20ft. by 9ft. in the centre, and two gates, each 20ft. by 5ft.—one at each end. The Hardoi Branch Canal has eight gates, each 20ft. by 9ft., while the Kheri Branch has six gates of the same dimensions.

An interesting scheme was carried out on the Bahgul feeder, which is led from the main canal at a point down-

stream of the syphon above referred to. In order to cross the River Deoha, and to utilise a long stretch of its bed as part of the Canal system, two sets of gates, one comprising eleven Ashford sluices controlling the river, and the other, four regulator sluices, controlling the canal, were erected. The manner in which this arrangement operates is as follows:—In times of flood the Deoha barrage is opened and the water allowed to pass unhindered after sufficient has been drawn off to supply the irrigation canal. During the dry season the barrage is closed, and the supply for irrigation is taken down the Bahgul feeder into the impounded river, from which it is drawn out on the opposite bank of the canal at the barrage site, some miles below the feeder.

The Deoha main barrage—see page 40—consists of eleven free-roller sluice gates each of 40ft. span by 12ft. deep. The sluices are designed for hand operation through worm and spur gears that drive the winding on which are wound the ropes for the gates and balance boxes. Watertightness is secured by means of truly formed staunching bars of circular section, which hang in the corners formed by the gate and grooves. The bottom is staunched by an adjustable plate on the gate making contact with a renewable teakwood face contained in the sill.

All the sluice gates and regulator gates, as well as the complete mechanical equipment for this canal system, were designed, manufactured and erected by Glenfield and Kennedy, Ltd., of Kilmarnock.

Provincial Letters.

THE MIDLANDS AND STAFFORDSHIRE.

(From our own Correspondent.)

Midsummer Quarterly Meeting.

MIDLAND ironmasters held their midsummer quarterly meeting in Birmingham to-day—Thursday. There was an excellent attendance, representatives being present from all parts of the country. An optimistic note prevailed though business was not as brisk as at the last meeting. Perhaps the chief reason for that was that there has recently been something of a scramble for supplies of raw iron and steel, and consumers have covered their requirements over the third quarter of the year, which is normally a quiet one. Moreover, the selling price situation is such as to permit of manufacturers seeing further ahead than they have been able to do for some time, and they candidly do not see the necessity for placing large contracts over and above those already given out at the moment. The market position is more clearly defined than usual, producers of both iron and steel having during the past quarter provided evidences of their desire not to jeopardise business by moving prices in advance of the market. They are evidently of opinion that it is better to leave demand and supply to determine prices. Furthermore, headway against the foreigner is being made in the steel trade, and native makers, no doubt, have in mind the consolidation of the ground won and the extending of their hold upon users of steel. They do not desire at this juncture to give the foreigner an opening. Consumers naturally prefer to use British steel where and when possible, and as long as prices are competitive with those of overseas producers they see no reason why they should send their business abroad. In these days of keen competition for work, however, they needs must buy to the best advantage; hence any advance in steel prices at home might leave room for continental material to slip in, and this native steelmakers wish to prevent as far as possible. Ironmasters quite recently intimated their intention of encouraging trade by keeping prices stable as long as possible, so that the position here is not so obscure as it has been of late. With an easier mind as to material prices, manufacturers and engineers have turned to weigh up the trade portents, and, judging by the views expressed at the quarterly meeting, they are, generally speaking, satisfied that business is on the mend and that, given freedom from any upset, they should continue to make progress. Industrialists in this area speak with confidence of the immediate future, and even constructional engineers, who have experienced a rather lean time of late, were rather more hopeful. General engineering is fairly active in the district. The local foundries have during recent weeks been consuming more pig iron, while automobile engineers are reasonably busy for the time of the year. Makers of railway rolling stock have some good orders on their books, but makers of heavy edge tools are finding business rather patchy and quiet. Boiler manufacturers are cheerful as to prospects, as are producers of gas and water tubes. The quarterly meeting should have the effect of brightening the spirits of iron and steel masters, and, indeed, of manufacturers generally, and it is much to be hoped the third quarter of the year will come up to expectations and provide an excess of business over that usually done in the "quiet season."

Raw Iron.

Consumers of pig iron who had conceded the premiums asked by blast-furnacemen before the decision of the Association to maintain prices on the recent basis are now asking themselves whether they have made a wise move. Consumptive demand for pig iron is slowly advancing in this district, and there are those who hold that iron bought at the enhanced rate will prove to be well worth the money. This week there has been some buying of iron at the minimum basis rate, but blast-furnacemen in the main are demanding premiums, especially for early deliveries. The premiums asked range from half-a-crown to 5s. per ton. Buying is quiet, however. Users have covered themselves over the current quarter and in some cases, it is reported, over the year. Furnacemen, too, are none too anxious to add to their present commitments in view of the coke position, and the substantial state of their order books. Buyers and sellers alike appear to be awaiting developments which may occur in relation of supply to demand. July, August, and September are usually quiet months, and consumption of pig iron generally declines. If the seasonal influences prevail this year prices may fall, but if consumption is maintained, with output of particular makes so far committed, furnacemen will almost certainly want prices above those now declared as the minimum and which have the sanction of the makers' association. These are Northamptonshire forge, £3 6s.; No. 1 foundry, £3 13s.; No. 2, £3 12s.; No. 3, £3 10s.; Derbyshire forge, £3 9s. 6d.; No. 1 foundry, £3 16s. 6d.; No. 2, £3 15s. 6d.; No. 3, £3 13s. 6d.; No. 4, £3 12s. 6d.—all per ton delivered at Black Country stations.

Finished Iron.

Demand for finished iron is maintained. There is no new feature in the trade on the week, the quarterly meeting failing to produce anything of moment. There is steady activity at the marked bar and the Crown bar mills. Prices are unchanged at £12 for marked iron, while £10 is the minimum for Crown iron of Staffordshire make, although supplies are obtainable at below this figure from makers outside this district. Some good orders for Crown bars have recently come to Staffordshire, despite the higher price. Nut and bolt iron is quoted £9 5s. upwards, but it sells only slowly, Belgian No. 3 iron used for the same purpose being procurable at £7 2s. 6d. per ton delivered here. Wrought iron tube strip remains in excellent call and selling prices are maintained at £11 per ton.

Steel.

There is very little change in the steel situation. There is only a moderate demand in this district for joists and sections, but plates are selling rather better. Special steels are providing the most movement, makers of commercial vehicles taking good quantities regularly. Steel hoops, which make £10 per ton, are in moderate request. Angles and joists are priced at £8 2s. 6d.; tees, £9 2s. 6d.; ship, bridge, and tank plates, £8 17s. 6d.; and boiler plates, £9 12s. 6d. Small steel bars are slightly easier, sellers not hesitating to do business at £8 5s. Continental offers have been more numerous of late, and native producers consider it wise to give ground somewhat in face of this competition. Steel tube strip is making something upward of £8 per ton. Foreign material is offered at £7 15s. Business is restricted. Mild steel billets range in value from £6 10s. to £6 15s.

Galvanised Sheets.

Galvanised sheets are a quiet market, with values of 24 gauge corrugateds ranging from £13 10s. to £13 15s. The export demand is quieter than usual at this period of the year, and some mills are becoming concerned as to the future activity of their plant.

£221,000 Sewage Works Scheme.

The Wolverhampton Corporation has decided upon a scheme of sewage purification the cost of which is estimated at £221,320. The scheme is, in part, a sequel to the complaints made some time ago, and the action taken against the Town Council regarding the injurious effect to the river Penk of the effluent from the council's outfall works. Since the advent of Messrs. Courtaulds' works to the town, extreme measures for dealing with the town's sewage have been taken. It was found that the land was incapable of dealing with the sewage, and it would have to be supplemented by some scheme of this kind. The scheme was adopted in principle in April last, when the Council sanctioned the construction of sludge-conditioning plant, at a cost of £6500, which is to form part of the general scheme of sewage purification. Messrs. Dodd and Watson, consulting engineers, in their report, gave details of the existing system of land irrigation, supplemented by two units of bio-aeration plant. It is proposed that the method of purification shall be changed. After more thorough settlement than the sewage now undergoes—possibly without the addition of milk of lime—the sewage will be given preliminary flocculation in the existing bio-aeration plant, and will be treated after that on a new area of bacteria beds before being discharged through the humus tanks into the brook. Experiments are now proceeding to discover the best medium for the bacteria beds. It is stated that the scheme presents a complete and satisfactory solution to the difficulties which have faced the Corporation in reference to sewage disposal.

Warwickshire Miners' Wages.

The Warwickshire Coalfield Joint Wages Board, after full consideration of the question, has decided to stand by the recent award of the independent chairman, Sir Walter Lawrence, which raised the percentage at five collieries to 43 per cent. in the county, as against 32 per cent. to which, by the action of the Board, it was reduced in the autumn of last year. The collieries concerned are now called upon to pay 43 per cent. on basic wages, as in all other collieries in the coalfield. The owners of the Exhall Colliery have decided to fall in with the award, and with the decision of their Wages Board, and work is proceeding at this colliery at date. At Binley Colliery 400 men are on strike, the management refusing to pay more than the 32 per cent. Officials of the Warwickshire Miners' Association and Mr. W. L. Cooke, a representative of the Ministry of Mines, are to visit Binley this week to try and solve the difficulties existing there.

Local Orders.

The Metropolitan Cammel Carriage, Wagon and Finance Company, of Birmingham, has secured from the South African administration an order for twenty-eight railway coaches to add to the order for 250 wagons for the railways of the same country, as reported in this letter last week. The new order is stated to be worth £78,000. It was secured after keen competition with other British, some continental and American firms. W. G. Bagnall, Ltd., of Stafford, is to supply the Great Western Railway Company with twenty-five six-wheeled coupled tank locomotives.

Unemployment.

Unemployment in the Midlands area continues on the increase, the latest returns showing a further advance of 2661, bringing the total up to 162,764. Increases are reported in sixteen of the twenty-two districts set out in the Ministry of Labour's statistics. The exceptions are Bilston, Dudley, Peterborough, Stoke-on-Trent, Wolverhampton, and Worcester. Birmingham's workless now number 22,756, of whom 4208 are known to be "stood off work temporarily" or to be on short time.

LANCASHIRE.

(From our own Correspondents.)

MANCHESTER.

Textile Machinists' "Conversations."

THE reference recently by the chairman of John Hetherington and Sons, Ltd., Manchester, to the question of rationalisation in the textile machinery industry was taken up also by Mr. J. S. Nuttall at the annual meeting of Platt Brothers and Co., Oldham. Mr. Nuttall described the past year like the one which preceded it, as one of anxiety. The demand for textile plant was not sufficient to enable the company to keep its works fully employed, and as similar conditions obtained in respect of most other firms engaged in this branch of engineering, prices were forced down. At the moment, however, Platt Brothers have more orders on their books than they had twelve months ago, although they are at lower prices. Mr. Nuttall, discussing the question of amalgamation, said that it was desirable that some agreement should be come to among textile machinists with the object of eliminating the suicidal competition that had existed for so long. To this end preliminary conversations, he stated, had taken place, and there was hope that future negotiations would lead to interesting developments.

Finding the Money.

Contrary to expectations in some quarters, the proposal of the Manchester Corporation Tramways Committee to substitute motor-omnibuses of the double-deck type for the existing single-deck tramcars on one of the routes outside the city is not having a smooth passage. The Committee's proposal, which was mentioned in this column last week, is to purchase a fleet of sixty omnibuses at a total cost of £110,000, but there has been a good deal of discussion in the City Council as to how the money should be raised, and the proposal has been referred back to the Tramways Committee for further inquiry. The consensus of opinion among members seems to be that the money should be taken from the reserve fund for renewals, which now amounts to about £350,000, and not be borrowed as the Committee suggest.

Training the Rubber Technician.

An important extension to the Newton Heath Technical School, Manchester, was opened by Lord Colwyn on Monday of this week. Largely through the financial assistance which has been forthcoming from some of the leading firms engaged in the rubber industry, of which Manchester is an important centre, a special department for training in rubber technology has been established in connection with the school, and a sum of £2000 has been provided by the Rubber Manufacturers' Association for the purchase of equipment. The new building that has been erected houses a special rubber workshop where instruction will be given by a teacher and demonstrator with practical works experience. An interesting fact is that guaranteed employment is offered by rubber firms who are members of the Association to apprentices who complete their training satisfactorily. In addition to day courses for apprentices in mechanical and electrical engineering, there is adequate provision at the school in the respective departments for the instruction of first and second year students who are transferred to Newton Heath from the Manchester College of Technology.

Liverpool and Industry.

An official move to attract new industrial enterprises to the city has been taken by the Liverpool Municipality, and a return is being made of vacant sites which are suitable for industrial purposes. There appears to be a feeling among the city leaders that the new East Lancashire road now in course of construction should prove a magnet, and consideration is being given to the many excellent sites in the outskirts of the city which have a frontage on this road.

Non-ferrous Metals.

Except in the case of spelter, the various sections of the non-ferrous metals market have continued the tendencies that were in evidence a week ago. So far as copper is concerned there has been no improvement in the amount of interest shown of late in standard brands, and although quotations at the moment of writing are slightly above the worst, values are appreciably lower on balance compared with a week ago, from 20s. to 25s. a ton representing the difference. There has been a certain amount of buying of refined metal going on on account of the cable-making industry, but it has been by no means extensive. Tin, however, has registered a further important advance, and current values are higher than they have been since about the middle of April, the rise being to the extent of about £3 a ton. An improvement in the statistical outlook has had its influence on prices, but there has also been some improvement in evidence in the demand. Inquiry for lead has been stimulated on occasion by the lower prices that have lately been ruling, though a good many consumers have been operating on a hand-to-mouth basis, and with plentiful supplies of the metal on offer there has been a further loss, this time to the extent of about 5s. a ton. There has been no appreciable improvement in the demand for spelter, but in this case, contrary to the experience of the past few weeks, prices have gained ground slightly.

Iron and Steel.

Although no less firm than it has been of late, the pig iron market here during the past week has pursued

a comparatively uneventful course. This may be attributed primarily to the fact that buyers are extensively bought already, and new commitments are now restricted both in number and in tonnage. Notwithstanding, however, that we are now within measurable distance of the height of the holiday season, Lancashire users are taking steady deliveries. Staffordshire iron is unchanged at the minimum rate of 73s. per ton, delivered in the Manchester zone; with Derbyshire at 72s.; Middlesbrough being quoted at about 86s. 6d., Scottish at 92s., and hematite iron at 87s. 6d. per ton, all delivered locally. A quiet trade is passing in Lancashire bar iron, with Crown quality quoted at £10 15s. per ton, and seconds at £9 15s. Steel deliveries to Lancashire constructional engineers are of limited volume, but there is a steady call for locomotive building material, and also for small bright-drawn bars. Except for small re-rolled bars, which are easier at about £8 5s. per ton, prices are firm, and there are no alterations to report. A little more interest has been shown in imported steel, and quotations for it keep steady all round.

The Late Mr. Robert G. Brooke.

I regret to have to record the death, on July 3rd, of Mr. Robert G. Brooke, chairman and managing director of Holden and Brooke, Ltd., at the age of seventy-one. Mr. Brooke served his apprenticeship at the works of Messrs. Sharp, Stewart and Co., Manchester, who were the licencees in this country for the original Giffard injector, and who now are merged in the North British Locomotive Company, Ltd. Along with Mr. H. Holden, of Thelwall, Cheshire, he founded in 1882 the firm of Holden and Brooke, the works of which were originally in Salford, but within a few years were moved to Sirius Works, West Gorton, Manchester, their present site, after which the firm was turned into a limited company. Although his health had been poor for some years, he took an active interest in the management of the firm, to within a few days of his death.

BARROW-IN-FURNESS.

Hematite.

The general tone of the hematite pig iron market is maintained, and makers are well fixed for orders for the next three months or more. The amount of booking for forward delivery mentioned some time ago is responsible for this condition, and there is no reason to expect a falling off in forward orders in view of the anticipated demand. There are twelve furnaces in blast, and the bulk of the business is on home account. There is a certain amount of overseas trade mostly in special qualities, and this trade continues to be steady. American business is still being done. The iron ore trade is steady, and the demand by outside smelters remains satisfactory. The steel trade is fairly well employed, but the mills, except those on hoops, are not on full time. A big tonnage of steel rails is being produced. The market, however, is not very brisk, and competition is still keen.

Shipbuilding.

The Isle of Man Steam Packet Company has placed with Vickers-Armstrongs, of Barrow, an order for a fast Cross-Channel steamer, which is to be completed in readiness for the 1930 season. This vessel, which will be 371ft. long and 50ft. in beam, with a draught of 12ft. 6in. is intended for the Fleetwood service, and will have a high speed. It is very satisfactory to Barrow that the order should go there, for in recent years the company's ships have been built at Birkenhead. The company has considered the internal-combustion engine, but is still inclined to pin its faith to reduction turbines. The horse-power will be 10,500. The last steamer built at Barrow for the Isle of Man Company was the "Ben-my-Chree." This vessel did excellent war service in the Mediterranean until she was sunk by Turkish shell fire. She was salved after the war, but did not come back to this country.

SHEFFIELD.

(From our own Correspondent.)

Increased Steel Production.

THERE is little change to report in the condition of ordinary lines of steel production, the general situation being summed up, as for a considerable time past, in the statement that basic steel is busy and acid steel very quiet. Figures of production for May are now available, and show that in the Sheffield district the output of steel was 103,400 tons, an increase of about 6000 tons on April, and 4000 tons on May of last year. The Lincolnshire figure, which represents practically all basic steel, was 65,500 tons, an increase of 300 tons on the month. In the railway steel branch conditions are still as unsatisfactory as they have been for about a couple of years, and there is hardly any ordering of wagons for private ownership. The busiest manufacturing departments are those which cater for special lines, such as automobile steel, stainless and non-corrodible steel, and these are turning out a great amount of work. The revival which has taken place in other centres has not yet, however, made its presence felt to any great extent in Sheffield.

Steel Works Reconstructions.

Ground for confidence in the future is afforded by the fact that steel makers at home and abroad are inquiring for new equipment. The reference to this matter in the annual report of Davy Brothers was amplified by Sir William Ellis at the meeting of the company. He said that they had better prospects of trade at present than they had had for some years past. The volume of orders had increased very considerably in the past three months, and they had now a very much larger order book than at any time over a long period. The reason for that was that the various steel works, both here and abroad, were realising that it was imperative to face the necessary financial outlay in order to introduce economies, hoping thereby to lessen the cost of production and to keep their plant at work. Although they had satisfactory foreign orders on hand, they had now a larger proportion of orders from English steel works and there was a considerable amount of future work under negotiation.

Lighter Steel Products.

There is increased activity at many engineering and other works in different parts of the country, and in consequence makers of tools and tool steel are receiving a larger volume of orders. The quantity of such commodities being used up at present is greater than for a long period. Sheffield's trade with Russia is on a small scale, and the possibilities of its expansion are hampered by the very long credit terms which buyers require. There have, however, been a few new orders for files and tool steel booked from that country lately. An expanding line is the manufacture of stainless steel studs for the direction of road traffic. The use of these studs is growing, not only in the United Kingdom, but abroad, and Firth-Derihon (Sheffield) installations of studs have now been put down at Sheffield, Southampton, Rotherham, Hull, Barrow-in-Furness, Keighley, York, Colne, Grimsby, North Lincolnshire, Copenhagen, Lausanne, Rotterdam, and Zurich.

The Cold Working of Steel.

The new laboratory for research into the cold working of steel at the Applied Science Department of the University of Sheffield, to which I referred on June 28th, was formally opened on Saturday by the Master of the Ironmongers' Company. Some fuller details of the plant than those previously given may be interesting. The mechanical equipment of the laboratory includes a wire and bar drawing plant constructed by George Crossley, Ltd., of Cleckheaton. Having a two-speed gear and variable speed motor, wire-drawing speeds of from 28ft. to 360ft. a minute may be obtained, and wires can be drawn of all sizes up to ¾in. diameter and rods up to 1in. diameter. The heavy drawing block is fitted with a friction clutch drive, and capstan type pull-in gear, which is also used for drawing steel bars, for which purpose a specially strong die stand is fitted at the end of the bench. The light wire block is fitted with the ordinary creeper drive, using spring shock-absorbing cushions. Capstan type pull-in gear is provided. The motor can develop 20 H.P. throughout its range of speed. The rolling mill plant has been constructed by W. H. A. Robertson and Co., Ltd., of Bedford. It has hardened steel rolls, 10in. diameter and 10in. face, and is fitted with two-speed gear-box and variable-speed motor, giving a range of rolling speeds from 52ft. to 319ft. a minute. The motor is capable of developing from 40 H.P. at 333 r.p.m. to 120 H.P. at 1000 r.p.m. The lubrication is by Messrs. Robertson's patented "Flood" system. Water cooling is provided for the rolls and roll bearings and for the oil in connection with the lubrication system. An alternative set of rolls is fitted with "Skefko" double-roller bearings. Machine-cut gears are used, and the equipment is of the latest type. The wire-drawing plant was presented by the Iron and Steel Wire Manufacturers' Association, and the cold rolling mill by the Cold Rolled Strip Manufacturers, the total cost of the plant being about £2000. Hardened steel rolls were given by Messrs. Hadfield and Messrs. Firth, of Sheffield.

Railway Work.

A good railway order has come to Sheffield during the week, in the shape of a contract for the construction of twenty-five six-wheeled coupled tank locomotives for the Great Western Railway, placed with the Yorkshire Engine Company. The railway company has ordered one hundred of these engines in all, and the other firms which are to make twenty-five each are the North British Locomotive Company, Ltd., Glasgow; Kerr, Stuart and Co., Ltd., Stoke-on-Trent; and Messrs. W. G. Bagnall, Ltd., Stafford. With regard to the proposed acquisition of the old firm of Henry Bessemer and Co., Sheffield, by John Baker and Co. of Rotherham—both of which firms are makers of railway axles and tires—it is now stated that, if the deal goes through, the Bessemer works will be closed as soon as reasonably possible, perhaps within six months, but the name of Bessemers will be kept alive on account of its world-wide fame. The policy of the railway companies as regards the manufacture of their own equipment is to be discussed at a conference of representatives of the Sheffield and Leeds Chambers of Commerce, manufacturers of rolling stock, rails, springs, and other articles required for railways, and possibly representatives of the railway companies, to be held shortly in Sheffield.

Bridge and Blast-furnaces.

Thos. W. Ward, Ltd., of Sheffield, has purchased the old suspension bridge which spans the Thames from Westminster to Lambeth, directly opposite Lambeth Palace. The bridge has done duty since 1862. It will be cut up into parts and taken to the works of Messrs. Ward at Silvertown. Two obsolete blast-furnaces at the New Works of the Staveley Coal and Iron Company, Ltd., were felled simultaneously last week-end by explosives. The furnaces have not been in operation recently, as the Staveley Company is now producing the whole of its pig iron at its Devonshire Works, Staveley. The methods there are more modern, and all the four furnaces have been working continuously for several months.

Colliery Development.

At the annual meeting of the Carlton Main Colliery Company, the chairman stated that as the workings of the Barnsley seam at Grimsthorpe were now a long way from the pit bottom, it had been decided gradually to reduce the output from this seam and at the same time develop the Haigh Moor seam, with a view to lessening costs without reducing the total output more than is required under the regulations of the Central Collieries Commercial Association. The development of the Haigh Moor seam is quite inexpensive, as the company is able to take advantage of a fault on the south side of the pit to the extent that a comparatively small drift will be required from the Barnsley bed level, with the further advantage that the Barnsley bed pit bottom arrangements and haulages are already available for dealing with this coal. The chairman added that very satisfactory results were being obtained from the intensive method of American machine mining which was commenced some twelve months ago at the Ferrymoor Colliery, belonging to the Hodroyd Comp ny.

Low-temperature Carbonisation.

The plant which has been erected by Low-Temperature Carbonisation, Ltd., on the premises of the Askern Coal and Iron Company, near Doncaster, was put in motion on Friday last by Miss Ellen Wilkinson. She, with other Members of Parliament, flew from London in an aeroplane run on petrol obtained from British coal by the low-temperature process, and a large number of motor coaches which travelled to Askern for the ceremony used the same fuel. The main object of the plant is the production of smokeless fuel from small coal and slack, which collieries experience most difficulty in disposing of; and petrol, crude oil, gas, &c., will also be produced. The Askern plant is capable of dealing with 2000 tons of coal weekly, and double that amount when contemplated additions are made.

A Sheffield Tramway Experiment.

At the annual Congress of the Tramways and Light Railways Association, which was held in Sheffield last week, Mr. G. H. Fletcher, of the Metropolitan-Vickers Electrical Company, read a paper in which he referred to an interesting experiment carried out by Mr. A. R. Fearnley, general manager of the Sheffield tramways. In this experiment the motor of the car was entirely spring-borne, and, the drive being through worm gear, it was possible to eliminate entirely the gear noise. It was found that in going over points and crossings the hammer blow was much reduced, but the reduction in the total noise of the car was not so much as one would expect. Previously it had been difficult to assess the proportional amount of noise contributed by the gears and by the truck, but in that case, when the gear noise was entirely eliminated, one realised how much of the ordinary noises of the car were due entirely to contact between the wheel and the metals.

Doncaster Silk Factory.

The principal orders have been placed for the building of the great artificial silk works which are to be erected at Doncaster for British Bemberg, Ltd. Work has been started on the foundations and excavations. This work is to be carried out by Sir Robert McAlpine and Sons, Ltd., of London, and the steel framework by Archibald D. Dawnay and Sons, Ltd., of Battersea. The architects are Messrs. Wallace Gilbert and Partners, of London.

Hull Level Crossings Abolition.

In connection with the proposed abolition of level crossings on the five main roads in Hull, which will cost £1,200,000, the L.N.E.R. Company has intimated that it will not be prepared to contribute more than £100,000. It has put forward a new scheme which will make it unnecessary to sink the roads under the crossings to make passenger subways, but instead provides for a circular loop line of high-level railways to carry railway traffic over the present roads. It has been decided to appoint a consulting engineer to advise the special committee in connection with the scheme, and to send a deputation to Mr. J. H. Thomas in the hope of inducing the Government to adopt the proposals under the scheme to relieve unemployment.

Hornsea Sea Wall.

The Ministry of Health has approved the proposed extension of the sea wall promenade at Hornsea, and the Urban Council of that place has given the Monnoyer British Construction Company, Ltd., of London, the contract, at a cost of £20,897. The wall will be extended southwards about 777 yards. The total cost of the scheme, including road-making and purchase of land, will be about £35,000.

NORTH OF ENGLAND.

(From our own Correspondent.)

Tees Dock Scheme Deferred.

THERE is to be a suspension in the development of the works of Synthetic Ammonia and Nitrates, Ltd., on the north bank of the Tees at Billingham, which have shown such rapid growth in the last ten years. Important constructional work had, it is understood, been abandoned, and it has also been decided to defer construction of the proposed new dock. For that purpose Imperial Chemical Industries, Ltd., has for some time been in negotiation with the Tees Conservancy Commissioners for the purchase of about 300 acres of reclaimed land in the vicinity of the Seal Sands, which the Commissioners are about to reclaim at considerable cost. The company is now seeking to secure a five or six years' option on the site at an annual rental which shall be considered part of the purchase price in the event of it being decided to proceed with the project within that period. The indecision of Imperial Chemical Industries, Ltd., in relation to its proposed dock has for some months held up the larger Tees improvement scheme of reclamation, but it will now be possible for the Commissioners to proceed without further delay with the important preliminary works of construction such as the slag reclamation bank, the reclamation of the foreshore behind the bank, and the extension of the culvert.

Cleveland Iron Trade.

The demand for Cleveland pig iron continues to increase, but there seems little likelihood of output being sufficiently enlarged to cope with it. A hopeful sign,

however, is the indication of producers returning to the market. For the past month or two they have refused to quote, but they are now opening their books for business over the last three months of the year, and are prepared to sell at current rates. They have no iron to offer for supply before the end of September. Merchants have only trifling quantities available, and have lately been unwilling to sell except when opportunity arose of obtaining an exceptionally high figure for a spot lot. Now that they are able to buy for the closing quarter of the year, they may part with iron a little more freely. The make of Cleveland pig iron is to be increased this month by the rekindling of three blast-furnaces, and hope is entertained that by September the number in operation will be increased to fifty. In pre-war times between sixty and seventy blast-furnaces were normally blowing, but modern plant is of substantially greater productive capacity, so that output of pig iron promises to touch about normal in the near future. Recognised market rates stand :—No. 1 foundry, 75s. ; No. 3 G.M.B., 72s. 6d. ; No. 4 foundry, 71s. 6d. ; and No. 4 forge, 71s.

Hematite Pig Iron.

Home and continental consumers are steadily buying East Coast hematite pig iron, but they endeavour to shade prices asked, and actual terms of sale vary a good deal after individual bargaining. Quotations keep comparatively low, but the feeling prevails that values will advance notwithstanding the forthcoming increase in production. Makers are well placed as regards orders, some of their running contracts being for delivery well ahead, and they have little prompt iron to offer. Merchants have command of rather considerable marketable parcels, but they are not pressing sales. Recognised market quotations are based on ordinary qualities at 74s. 6d.

Ironmaking Materials.

There is little new business in the foreign ore trade. Merchants have next to none to sell, and consumers are heavily bought over the next eighteen months, but imports in fulfilment of running contracts are not coming forward satisfactorily, owing to the difficulty of obtaining steamers. Quotations are based on best Rubio at fully 23s. 9d. c.i.f. Tees. Blast-furnace coke is scarce, and sellers are not keen to commit themselves extensively. Good medium qualities command 21s. 3d. delivered at North-East Coast works.

Manufactured Iron and Steel.

Active conditions prevail in practically every section of the manufactured iron and steel trade. Producers of manufactured iron are generally well placed as regards orders, and report a little new work coming to hand. Semi-finished steel producers are very busy and have no difficulty in arranging contracts at current rates, which exclude continental rivals from home markets. Prices are inclined to advance. Output of finished is on a large scale and likely to continue so, but while manufacturers are well sold, they admit that demand is somewhat irregular.

Iron Trade Wages Increased.

As a result of the quarterly ascertainment, the wages of blast-furnacemen employed at works in the North of England have been advanced by 1 per cent., bringing them to 10·25 per cent. above the standard. The ascertained price of No. 3 Cleveland pig iron for April, May and June was 64s. 5·28d. per ton, an increase of 1s. per ton, as compared with the ascertained price of the preceding quarter. Cleveland ironstone miners' wages have been advanced by 1¼ per cent. The district percentage has been for some time in excess of the formula, and the mineowners have intimated that the men must not regard this as a permanent condition.

The Coal Trade.

A good general note of steadiness governs the Northern coal market, and there are a few improved features. Buyers are evincing a keen interest in forward requirements as well as for prompt supplies, and there appears to be no doubt about the present volume of trade being maintained over the remainder of the summer months. Fitters anticipate an expansion for the back end of the year, with a consequent improvement in values. Thus, in spite of offers of forward trade at prices which in some cases are only a few pence below maximum current quotations, fitters are disposed to be a little reserved. Durham coking coal is reported to have been purchased in substantial quantities over the next twelve to eighteen months at around 16s., and there are inquiries for extra supplies on a similar basis. Sellers, however, are not easy to find, and it is said that offers of 16s. 6d. to 17s. for coking coal over the rest of the year have been declined. Durham steams, which are at 18s. to 18s. 6d. for large and 12s. to 12s. 6d. for smalls, are experiencing a good business. Gas coals are scarce for prompt requirements, and are substantially sold to the end of the year. Best gas fuel is quoted at 16s. 9d., and second qualities at 16s. to 16s. 3d. Bunkering fuel is selling well at 17s. to 17s. 6d. for bests and superiors, and 16s. to 16s. 3d. for lower grades. The prompt position of the Northumberland steam coal collieries appears to be a little stronger. Under a good demand and a lack of sellers the price for best qualities has stiffened and a general basis of 15s. is now indicated. The small steams trade keeps a fairly regular level, and values are undisturbed at 8s. 6d. to 10s. Good prices continue to be commanded by producers of coke, and the tendency of the market is in their favour. Some of them have arranged for the disposal of outputs to the end of the year, and there are large supplies in the hands of merchants. The present inquiry reflects a promising outlook and firm prices are indicated, gas coke remaining at 21s. 6d. to 22s. ; patent foundry coke at 20s. 6d. to 21s. for ordinary kinds and 24s. to 26s. for specials. Beehive coke is 28s. to 30s.

SCOTLAND.

(From our own Correspondent.)

The Annual Holiday.

THE annual holiday season is due to commence this week, and many engineering works, ironworks, and collieries will close down until Monday, July 22nd. In some cases the restart may be delayed in accordance with the state of the order books. So far as can be ascertained, there has been no rush for deliveries over the holiday time, and markets preserved the same state of partial inactivity which has characterised the position for some time back.

Steel.

Makers of heavy steel have, as a rule, sufficient work on hand to keep works employed until the start of the holidays, while some, it is said, are assured of a fairly good restart. In other cases, however, the stoppage will extend to a fortnight at least. The demand for steel sheets continues irregular. Light gauges are comparatively well booked, and the production is large, but the heavier descriptions are rather flat at present. The export market has not yet fulfilled expectations, but the outlook in this respect is brighter. Business in tubes has slackened a trifle, but the production is being maintained at the same high level as formerly, as makers anticipate further developments.

Iron.

The market for bar iron preserves a rather dull aspect, and there is no apparent prospect of an early improvement. Prices are still nominally unchanged, despite the higher values existing in other districts. Steel re-rollers are much quieter, owing to severe continental competition at home and abroad. Prices, however, are still nominally unchanged at £8 home and £7 15s. per ton export.

Pig Iron.

The pig iron market is without change. Business in hematite is fairly steady, but of little account, and foundry qualities are very inactive at present. Minimum prices are unchanged at 78s. per ton for hematite delivered steel works, 77s. No. 1 foundry, and 74s. 6d. No. 3 foundry at furnaces.

Scrap.

Supplies of scrap materials are a shade more plentiful, but prices are, if anything, a trifle harder at 75s. per ton heavy acid steel and 71s. 3d. per ton heavy basic.

Coal.

With the approach of the holidays and the shortage of boats, prompt shipping business is practically at a standstill, and collieries are not disposed to entertain forward transactions, owing to the uncertainty caused by the possibility of Government action in the nature of reorganisation of the industry. In the West of Scotland the collieries have little home business on hand, and apart from best splints all qualities of large coal are inactive. Lothians steams are in limited supply, and are faily steady in price. Best Fifeshire steams are very well sold, but the production has been curtailed a little, owing to the shortage of steamers. In all districts washed nuts are firm for shipment. Aggregate shipments amounted to 306,945 tons, against 259,566 tons in the preceding week and 219,852 tons in the same week last year.

WALES AND ADJOINING COUNTIES.

(From our own Correspondent.)

Coal Trade Conditions.

No special feature that is new has marked the steam coal trade of this district during the past week. If anything, the conditions are slightly improved, but it can scarcely be said that this is more than temporary, because tonnage is so uncertain. Last week exports from South Wales showed a little advance upon the preceding week, and came to just over 530,000 tons, as against rather more than 514,000 tons, but this increase was due to the expansion in shipments of anthracite, which were higher last week than they have been during any previous week since October last. As a matter of fact, the docks at Swansea have been well engaged, but this cannot be said of the more eastern ports in the Channel. At the end of last week there were round about thirty idle tipping appliances at the various docks, but although tonnage arrivals over the week-end were none too satisfactory, additional steamers have come to hand since, and on Tuesday the number of waiting steamers was practically equal to the number of idle appliances. It would be rather optimistic to expect these conditions to continue, as exporters are still experiencing great difficulty in fulfilling many of their orders, owing to the scarcity of suitable tonnage seeking employment. Nevertheless, chartering operations last week were slightly better than during the previous fortnight, but still the amount of tonnage being taken up is insufficient to bring about really active conditions in the coal shipment line. The inquiry for prompt loading is on a fair scale, but by no means heavy, and as regards forward operations there is a feeling that foreign buyers are inclined to act on the belief that coal prices during the next six months or so are likely to improve. Among contracts concluded, it is reported that the Buenos Aires Electricity Works have bought another 100,000 tons of nuts and beans from one of the leading Cardiff undertakings for delivery over the next twelve months. A fortnight or so ago the same buyers were understood to have contracted with two local exporting firms for the supply of 100,000 tons of similar coals by each of them.

Towards Rationalisation.

Reference has already been made on several occasions to the steps which coalowners are taking to improve the position of the industry, and the committee appointed is still considering the scheme by which production can be adjusted to market demands, in conjunction with price regulation. There is, of course, another way in which a common policy can be secured, and that is for leading undertakings to link up and assume such a commanding position that they can dictate. A few weeks ago reference was made to the rumours current respecting the association of interests, but during the last week or so these rumours have been much more insistent. In fact, the names of the firms connected with the fusion scheme have been freely mentioned, viz., Guest, Keen and Nettlefold, Ltd., the Powell Duffryn Steam Coal Company, Ltd., Wm. Cory and Son, Ltd., and Gueret, Llewellyn and Merrett, Ltd. Exactly on what lines negotiations are proceeding is not known, but for all or any of these firms to amalgamate would be a combine of combines. It is stated that negotiations have got past the preliminary stage, but will take considerable time to mature fully. Whether complete amalgamation is aimed at is not known, but, at any rate, not only production but distribution of the coals, both for export and inland, will be covered by the arrangements come to. Such an association of interests would have very far-reaching effects, inasmuch as inter-competition would be eliminated and virtually business would be centralised.

Dock Development.

An effort is being made to enlist the support of the Minister dealing with unemployment for a scheme which would be of great importance to Cardiff and lead to its development. The scheme covers the construction of docks in the area which lies between Penarth Head and Queen Alexandra Dock, Cardiff. It is not a new scheme, by any means. It has been discussed off and on for a quarter of a century or more, but the view of the civic authorities is that now is the time to press the matter forward, and secure its inclusion if possible in the programme of the Minister of Employment as worthy of the support of the Government. The Lord Mayor of Cardiff and others had an interview last week with Treasury officials, who promised to lay the whole matter before Mr. J. H. Thomas and his technical advisers, and submit the plans which they had in their possession, and which were drawn up when the scheme was first brought forward. Hopes are entertained that the American–Canadian trade and passenger traffic will be greatly developed, but as a preliminary to this it is realised that considerable alterations and improvements at the docks are necessary.

Current Business.

There is no marked change in the general tone of the steam coal market. So far as large qualities are concerned, the demand is still below what is required to make collieries comfortable. The position of individual concerns varies considerably. Some are very well off for prompt tonnage, and others are distinctly hard up for an immediate outlet for their coals. Prices are for the most part at the minimum, but in the case of smalls and sized descriptions the market is quite firm, owing to the production of these grades being somewhat restricted. Coke is steady, but patent fuel is on the quiet side. Pitwood is offered more freely, and has weakened to round about 29s. 3d.

EDUCATIONAL INTELLIGENCE.

UNIVERSITY OF BRISTOL.—A prospectus of the Faculty of Engineering, which is provided and maintained by the Society of Merchant Venturers in the Merchant Venturers' Technical College, Bristol, has just reached us. Courses of study are available at the College for persons intending to engage in civil, mechanical, electrical or automobile engineering, and particulars of these courses are given in the prospectus. The ordinances and regulations relating to degrees and diplomas in engineering subjects are included, and some particulars of the Bristol sandwich system of training engineers are also given. The prospectus can be obtained from the registrar of the Merchant Venturers' Technical College, Bristol.

CONTRACTS.

FILTRATORS, Ltd., of Astor House, Aldwych, London, W.C 2, has received an order from the Egyptian Government for twelve of its standard size filtrators for preventing scale in boilers, &c., for the Egyptian Railways.

GUEST AND CHRIMES, Ltd., of Rotherham, have received the following orders :—(*a*) For two 18in. and one 15in. Venturi meters and recorders ; also Sancleen sand-washing machine, for the City of Norwich Waterworks ; and (*b*) for one 10in. and one 4in. Venturi meters and recorders from the Metropolitan Railway.

NEGRETTI AND ZAMBRA, of 38, Holborn Viaduct, London, E.C. 1, have just received from the British Air Ministry an order for 820 of their patented mercury-in-steel distance-reading thermometers for engine oil temperatures on aircraft. This is the eighth successive order for a total of nearly five thousand instruments which the Ministry has placed with the firm in the last few years.

MISUSE OF INSTITUTION INITIALS.—It having come to the notice of the Council of the Institution of Automobile Engineers that certain unauthorised persons were making use of the letters A.M.I.A.E. after their names, the Council recently instructed its solicitors to institute proceedings against an engineer who had formerly been an Associate Member of the Institution but whose name had been removed from the list of Associate Members. On June 11th, 1929, Mr. Justice Maugham granted an interim injunction restraining the defendant from using the letters A.M.I.A.E. on his letter paper, business cards, or other documents in the course of his business as an engineer or otherwise in such a manner as to lead to the belief that he was an Associate Member of, or connected with, the Institution. On June 14th, 1929, the defendant attended before the judge and consented to the hearing of the motion being treated as the trial of the action, whereupon the judge granted a perpetual injunction and ordered the defendant to pay the costs of the action.

Current Prices for Metals and Fuels.

IRON ORE.

N.W. COAST—	
(1) Native	19/6 to 22/–
(1) Spanish	24/–
(1) N. African	24/–
N.E. COAST—	
Native	18/– to 21/–
Foreign (c.i.f.)	23/9

PIG IRON.

	Home. £ s. d.	Export. £ s. d.
(2) SCOTLAND—		
Hematite	4 0 0	—
No. 1 Foundry	3 18 6	—
No. 3 Foundry	3 16 0	—
N.E. COAST—		
Hematite Mixed Nos.	3 14 0	3 14 0
No. 1	3 14 6	3 14 6
Cleveland—		
No. 1	3 15 0	3 15 0
Silicious Iron	3 15 0	3 15 0
No. 3 G.M.B.	3 12 6	3 12 6
No. 4 Foundry	3 11 6	3 11 6
No. 4 Forge	3 11 0	3 11 0
Mottled	3 10 6	3 10 6
White	3 10 6	3 10 6
MIDLANDS—		
(2) Staffs.—	(*Delivered to Station*)	
All-mine (Cold Blast)	—	—
North Staffs. Forge	3 11 0	—
,, ,, Foundry	3 13 6	—
(3) Northampton—		
Foundry No. 3	3 10 0 to 3 12 6	—
Forge	3 6 0 to 3 8 6	—
(1) Derbyshire—		
No. 3 Foundry	3 8 6 to 4 1 0	—
Forge	3 4 6 to 3 17 0	—
(3) Lincolnshire—		
No. 3 Foundry	3 12 6	—
No. 4 Forge	—	—
Basic	—	—
(4) N.W. COAST—		
N. Lancs. and Cum.—		
Hematite Mixed Nos.	4 5 6 (a) / 4 7 6 (b) / 4 11 0 (c)	—

MANUFACTURED IRON.

	Home. £ s. d.	Export. £ s. d.
SCOTLAND—		
Crown Bars	10 5 0	9 15 0
Best	—	—
N.E. COAST—		
Iron Rivets	11 10 0	—
Common Bars	10 15 0	—
Best Bars	11 5 0	—
Double Best Bars	11 15 0	—
Treble Best Bars	12 5 0	—
LANCS.—		
Crown Bars	10 15 0	—
Second Quality Bars	9 15 0	—
Hoops	13 0 0	—
S. YORKS.—		
Crown Bars	11 0 0	—
Best Bars	11 10 0	—
Hoops	12 0 0	—
MIDLANDS—		
Crown Bars	10 0 0	—
Marked Bars (Staffs.)	12 0 0	—
Nut and Bolt Bars	9 0 0 to 9 5 0	—
Gas Tube Strip	11 0 0	—

STEEL. (*d*)

	(6) Home. £ s. d.	(7) Export. £ s. d.
(5) SCOTLAND—		
Boiler Plates	10 10 0	10 10 0
Ship Plates, ½in. and up	8 12 6	7 12 6
Sections	8 2 6	7 2 6
Steel Sheets, ¼in.	9 0 0	8 12 6
Sheets (Gal. Cor. 24 B.G.)	13 17 6	13 12 6 to 13 15 0

STEEL (*continued*).

	Home. £ s. d.	Export. £ s. d.
N.E. COAST—		
Ship Plates	8 12 6	—
Angles	8 2 6	—
Boiler Plates	12 15 0	—
Joists	8 2 6	—
Heavy Rails	8 10 0	—
Fish-plates	12 0 0	—
Channels	10 5 0	£9 to £9 5s.
Hard Billets	8 2 6	—
Soft Billets	6 17 6	—
N.W. COAST—		
BARROW—		
Heavy Rails	8 10 0	—
Light Rails	8 15 0 to 9 0 0	—
Billets	6 15 0 to 9 10 0	—
MANCHESTER—		
Bars (Round)	9 2 6	—
,, (Small Round)	8 5 0 to 8 7 6	—
Hoops (Baling)	10 0 0	9 15 0
,, (Soft Steel)	9 0 0	8 15 0
Plates	8 17 6 to 9 2 6	—
,, (Lancs. Boiler)	9 12 6 to 9 17 6	—
SHEFFIELD—		
Siemens Acid Billets	9 10 0	—
Hard Basic	9 2 6 and 9 12 6	—
Intermediate Basic	7 12 6 and 8 2 6	—
Soft Basic	7 0 0	—
Hoops	9 10 0 to 9 15 0	—
Soft Wire Rods	8 10 0	—
MIDLANDS—		
Small Rolled Bars	8 5 0 to 8 15 0	—
Billets and Sheet Bars	6 12 6 to 6 15 0	—
Sheets (20 W.G.)	11 10 0 to 12 0 0	—
Galv. Sheets, f.o.b. L'pool	13 10 0 to 13 15 0	—
Angles	8 2 6	—
Joists	8 2 6	—
Tees	9 2 6	—
Bridge and Tank Plates	8 17 6	—
Boiler Plates	9 17 6	—

NON-FERROUS METALS.

SWANSEA—	
Tin-plates, I.C., 20 by 14	18/– to 18/3
Block Tin (cash)	204 10 0
,, ,, (three months)	207 15 0
Copper (cash)	72 3 9
,, (three months)	72 13 9
Spanish Lead (cash)	23 1 3
,, ,, (three months)	23 2 6
Spelter (cash)	26 17 6
,, (three months)	25 17 6
MANCHESTER—	
Copper, Best Selected Ingots	76 10 0
,, Electrolytic	84 15 0
,, Strong Sheets	110 0 0
,, Tubes (Basis Price), lb.	0 1 3½
Brass Tubes (Basis Price), lb.	0 1 1½
,, Condenser, lb.	0 1 3½
Lead, English	24 12 6
,, Foreign	23 2 6
Spelter	26 0 0
Aluminium (per ton—raw ingot)	£95

FERRO ALLOYS.

	Per Ton.	Per Unit.
Tungsten Metal Powder	3/– per lb.	
Ferro Tungsten	2/9 per lb.	
Ferro Chrome, 4 p.c. to 6 p.c. carbon	£24 0 0	7/6
,, ,, 6 p.c. to 8 p.c.	£23 0 0	7/–
,, ,, 8 p.c. to 10 p.c.	£23 0 0	6/6
,, ,, Specially refined		
,, ,, Max. 2 p.c. carbon	£34 0 0	12/–
,, ,, ,, 1 p.c. carbon	£38 0 0	15/–
,, ,, ,, 0·70 p.c. carbon	£42 0 0	17/–
,, ,, ,, carbon free	1/2 per lb.	
Metallic Chromium	2/6 per lb.	
FerroManganese (per ton)	£13 15 0 for home / £13 10 0 for export	
,, Silicon, 45 p.c. to 50 p.c.	£12 0 0 scale 5/– per unit	
,, ,, 75 p.c.	£19 10 0 scale 6/– per unit	
,, Vanadium	13/– per lb.	
,, Molybdenum	4/– per lb.	
,, Titanium (carbon free)	1/– per lb.	
Nickel (per ton)	£170 to £175	
Ferro-Cobalt	9/4 per lb.	

FUELS.

SCOTLAND.

(*Prices not stable.*)

	Export.
LANARKSHIRE	
(f.o.b. Glasgow)—Steam	13/–
,, ,, Ell	14/–
,, ,, Splint	15/6 to 16/–
,, ,, Trebles	14/6
,, ,, Doubles	13/6
,, ,, Singles	12/6
AYRSHIRE—	
(f.o.b. Ports)—Steam	13/6
,, ,, Jewel	16/6
,, ,, Trebles	13/9
FIFESHIRE—	
f.o.b. Methil or Burntisland—Steam	12/– to 15/–
Screened Navigation	17/6 to 18/6
Trebles	14/6 to 15/6
Doubles	13/6 to 14/–
Singles	12/–
LOTHIANS—	
(f.o.b. Leith)—Best Steam	13/–
Secondary Steam	12/6
Trebles	14/6
Doubles	13/6
Singles	12/3

ENGLAND.

	Inland.	Export.
(8) N.W. COAST—		
Steams		24/– to 25/–
Household		38/– to 51/–
Coke		23/6 to 25/–
NORTHUMBERLAND—		
Best Steams		14/6 to 15/–
Second Steams		13/9 to 14/–
Steam Smalls		9/6 to 10/6
Unscreened		13/– to 13/6
Household		21/– to 26/–
DURHAM—		
Best Gas		16/6 to 16/9
Second		16/– to 16/6
Household		21/– to 27/–
Foundry Coke		22/– to 28/–
SHEFFIELD—		
Best Hand-picked Branch	27/– to 28/6	—
Derbyshire Best Bright House	20/– to 23/–	—
Best House Coal	19/6 to 20/6	—
Screened House Coal	17/6 to 18/6	—
,, ,, Nuts	16/– to 17/6	—
Yorkshire Hards	15/6 to 16/6	—
Derbyshire Hards	15/6 to 16/6	—
Rough Slacks	8/6 to 9/6	—
Nutty Slacks	6/– to 7/–	—
Smalls	2/– to 4/–	—
Blast-furnace Coke (Inland)	14/6 at ovens	—
Furnace and Foundry Coke (Export), f.o.b.		20/– to 21/–

CARDIFF— (9) SOUTH WALES.

Steam Coals :	
Best Smokeless Large	19/9 to 20/–
Second Smokeless Large	19/6 to 19/9
Best Dry Large	18/9 to 19/–
Ordinary Dry Large	18/– to 18/6
Best Black Vein Large	18/3 to 18/6
Western Valley Large	18/– to 18/3
Best Eastern Valley Large	17/9 to 18/–
Ordinary Eastern Valley Large	17/3 to 17/9
Best Steam Smalls	13/9 to 14/3
Ordinary Smalls	12/6 to 13/–
Washed Nuts	20/– to 23/6
No. 3 Rhondda Large	20/– to 21/–
,, ,, Smalls	15/6 to 16/–
No. 2 ,, Large	17/– to 17/6
,, ,, Through	15/6 to 16/6
,, ,, Smalls	13/6 to 14/–
Foundry Coke (Export)	26/6 to 36/–
Furnace Coke (Export)	21/– to 23/–
Patent Fuel	20/– to 21/6
Pitwood (ex ship)	29/6 to 30/–
SWANSEA—	
Anthracite Coals :	
Best Big Vein Large	33/– to 36/6
Seconds	27/6 to 30/–
Red Vein	23/– to 27/–
Machine-made Cobbles	40/– to 44/–
Nuts	40/– to 44/–
Beans	23/6 to 25/6
Peas	18/– to 19/–
Breaker Duff	9/– to 9/6
Rubbly Culm	10/3 to 10/9
Steam Coals :	
Large	18/– to 19/–
Seconds	17/– to 18/–
Smalls	11/3 to 13/–
Cargo Through	15/6 to 16/6

(1) Delivered. (2) Net Makers' Works. (3) f.o.t. Makers' Works, approximate. (4) Delivered Sheffield. (5) Glasgow, Lanarkshire and Ayrshire.

(6) Home Prices—All delivered Glasgow Station. Boiler Plates 10/– extra delivered England. (7) Export Prices—f.o.b. Glasgow. (8) Except where otherwise indicated. coals are per ton at pit for inland and f.o.b. for export, and coke is per ton on rail at ovens and f.o.b. for export. (9) Per ton f.o.b. (*a*) Delivered Glasgow. (*b*) Delivered Sheffield.

(*c*) Delivered Birmingham (*d*) Rebate 12/6 joists and 10/– all other materials if home consumers confine purchases solely to British products.

French Engineering Notes.

(From our Correspondent in Paris.)

Railway Electrification.

THE commercial and industrial interests of the various provinces are looked after by associations known as "groupements economiques," and the one comprising the Dauphine holds meetings annually to discuss matters affecting the hydraulic interests of that region. At the meeting held at Grenoble last week an interesting communication was made by Monsieur Japiot upon the electrification of the P.L.M. Railway. The conditions under which that work is being done are quite different from those of the Orleans and Midi schemes, which were carried out by the companies providing their own energy. Having to install their own plants in the Pyrenees and the Massif Central and connect them up so that there should be an interdependence amongst them in order to ensure supplies of current to Paris beyond what was required by the railways, the companies had to carry out their electrification proposals as a whole. The P.L.M. Company, on the other hand, found that it could obtain all the energy it needed from existing power stations, and it could therefore electrify the system in stages and at the times most convenient to itself. It was thus able to suspend entirely the electrification work during two critical periods when its energies had to be diverted to other purposes. At present the only section electrified is that between Chambéry and Saint-Jean-de-Maurienne, and next year it is expected that the section between the latter town and Modane will also be put into service. The third rail system is employed, as it is stated to be the most suitable for the heavy traffic on this section of the P.L.M. line. On account of the high cost of electric locomotives only two types of machines are used, one for ordinary and the other for express trains, the latter being of 2400 horse-power; but trials are now being carried out with a locomotive of 5400 horse-power, having six driven axles, constructed by a group composed of Oerlikon, the Société des Batignolles and the Compagnie Générale de Construction de Locomotives. The P.L.M. Company will absorb about 20 million kWh a year, and the energy will be supplied by three great producing companies, the total capacity of which is 250 million kWh a year.

Tidal Power.

The company which was formed, largely with the aid of foreign capital and with the participation of the State, to lay down an experimental tidal power plant at Aber W'rach, near Brest, has so far done little, and two recent events would seem to imply that it has abandoned its original scheme and may adopt another system, to which reference is made in a report presented to the shareholders. No information, however, is given about this new system. A description of the original proposals has already been published in these columns. The installation was to consist of reversible turbines, which would be driven on the rising and falling tides, and the first idea of supplementing this plant with a barrage across the mouth of a neighbouring river was abandoned in favour of a heat plant. The company's report was issued almost simultaneously with the announcement that the State was taking the matter up again with a view to a renewal of the concession and the payment of its contribution towards the cost of the experiment. The French attach considerable importance to a successful solution of this problem, which, they believe, will relieve them entirely of a dependence on foreign fuel supplies.

Rolling Stock.

Locomotive and wagon builders are complaining of the very difficult situation in which they are placed by the importation of so much rolling stock from Germany on account of reparations. The State Railways are the principal offenders in this respect, and they put forward as an excuse that they are obliged to take German material because they have not the means to purchase locomotives and wagons at home, while the other railway companies have every inducement to take advantage of German reparations on account of the long terms of credit allowed. During the first five months of the year the railway companies did not order a single steam locomotives from French builders and only 260 passenger coaches and 4470 vans and trucks. It is true that since then several orders have been distributed. The Chambre Syndicale des Constructeurs de Matérial de Chemins de Fer declared that during the past five years the work given out by the home companies represented only 19 per cent. of the capacity of production of locomotive builders, 16 per cent. of the coach building capacity and 13 per cent. of what the builders of vans and trucks could supply. The situation is therefore regarded as very serious, and the Chambre Syndicale is endeavouring to secure better treatment under the new purchasing programme which the Superior Railway Council is preparing for the next five years. So long as a large share of the work goes to Germany the orders available must be considerably below the home productive capacity, and the only hope for builders lies in the probability of the supply of German goods on account of reparations being much reduced as the result of the new arrangement with creditor countries.

The Port of Paris

As part of the programme for increasing the capacity of the port of Paris in order to deal with the traffic which it is expected will grow with improvements being made to navigation facilities by canals with the Nord and by the Seine with Rouen, the Ourcq Canal between Paris and the limit of the Department of the Seine is being enlarged to provide accommodation for boats of 1000 tons. One section has been completed at Pantin, where a basin 850 m. long and 71 m. wide was officially opened last week. The work entailed considerable expense on account of the pile driving involved and of making the floor impermeable. The port will be particularly well equipped with elevating machinery, and extensive warehouses will be built.

British Patent Specifications.

When an invention is communicated from abroad the name and address of the communicator are printed in italics.

When an abridgment is not illustrated the Specification is without drawings.

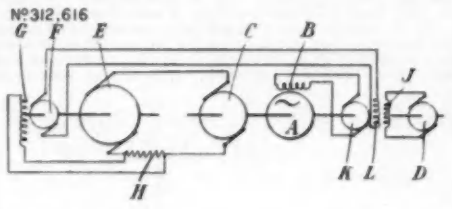
Copies of Specifications may be obtained at the Patent Office, Sale Branch, 25, Southampton-buildings, Chancery-lane, W.C., at 1s. each.

The date first given is the date of application; the second date, at the end of the abridgment, is the date of the acceptance of the complete Specification.

DYNAMOS AND MOTORS.

312,616. February 27th, 1928.—EXCITATION OF DYNAMO-ELECTRIC MACHINES, The English Electric Company, Ltd., of Queen's House, 28, Kingsway, London, W.C. 2; and James Cooper Wilson, of Siemens Works, Stafford.

This invention relates to dynamo-electric machine groups of the kind in which an alternating-current synchronous motor drives a direct-current generator which feeds a motor driving a load varying both in speed and torque. Under such conditions it has been recognised that the load on the synchronous motor will vary within wide limits and that for satisfactory working it is desirable that the excitation of this motor should have a variable component, the value of which is dependent upon the power given out by the direct-current generator. According to this invention, the alternating-current synchronous motor A,

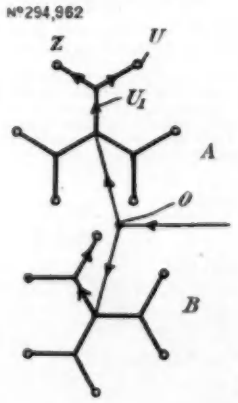


provided with a field winding B, is arranged to drive a direct-current generator C and its constant-voltage exciter D. The generator C supplies current to a motor E, which may be a reversible winding motor. The motor E drives an auxiliary exciter F, either by direct coupling or through gearing, and the field G of the exciter is supplied with current proportional to the armature or load current of the motor E, for example, from the terminals of a shunt H. The constant-voltage exciter D supplies one field winding J of an intermediate exciter K, which is also driven by the synchronous motor A, the other field winding L of which is supplied with voltage, varying with the load on the motor E from the exciter F. The intermediate exciter K then supplies variable voltage to the field winding B dependent upon the combined effect of the constant current in its field winding J and variable current in the field winding L.—*May 27th*, 1929.

TRANSFORMERS AND CONVERTERS.

294,962. August 1st, 1928.—ELECTRIC TRANSFORMERS, *International General Electric Company, Incorporated, of 120, Broadway, New York.*

Experiments have shown that, where two six-phase secondary windings connected in star formation are used, a perfect twelve-phase load of the rectifier does not ensue under all circumstances. According to this invention, the neutral points of both systems are led to the common zero point O to which the

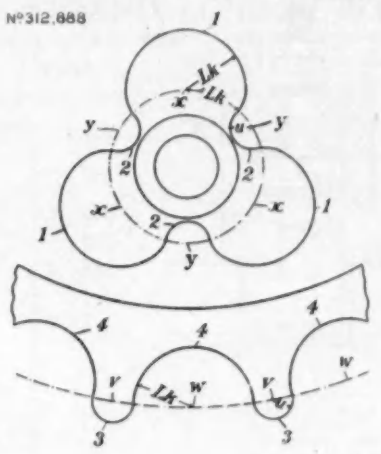


current of the rectifier plant returns, and the current flows towards the cathode from the twelve phases which are connected with the anodes of the rectifier. The ampère turns of the transformer A and those of the transformer B are completely compensated on the primary and secondary side, as indicated by arrows. Three phases always operate simultaneously, and in the case under consideration the phases Z, U_1 and U.—*June 6th*, 1929.

TRANSMISSION OF POWER.

312,888. October 26th, 1928.—TOOTHED GEARING, L. Jones, Carterton, Oxford; and J. H. T. Pougher, 8, Stanley-road, Sutton, Surrey.

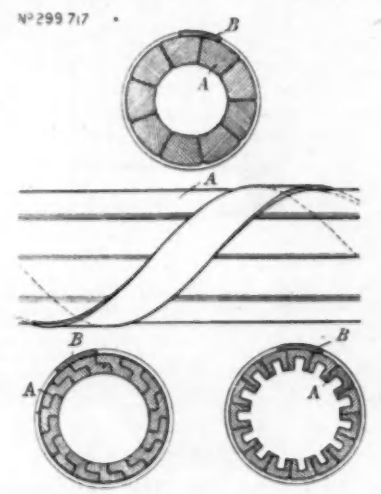
We give herewith the inventors' description of the formation of gear teeth, which are said to be easy of manufacture and capable of transmitting heavy loads per unit of width. Both wheels are made of axial halves, with the teeth of the two halves staggered. The "pinion pitch circle is divided into six equal arcs at points which are alternately designated *x* and *y*. The gear wheel pitch circle is divided into thirty six equal arcs at points which are alternately designated V and W. It will be clear that each arc *x y* is equal to each arc V W, being equal to the common pitch distance arc of the composite wheels. Three-quarters of the chord of the arc V W will be hereinafter termed the link L K. One-quarter of the chord of said arc V W will be hereinafter termed the dimension *u*. The three addendum curves 1 of the component pinion are described with the respective points *x* as centre and the link L *k* as radius in the form of a flexible taut cord bending around said pinion pitch circle. Thus the mid portion of the addendum curve outside the tangent to the pitch circle at the point *x* is semi-circular and the end portions between said tangent and the pitch circle are involute. The three intermediate dedendum curves 2 of said component pinion are described with the respective points *y* as centre and the dimensions *u* as radius. The eighteen addendum curves 3 of



the component gear wheel are described with the respective points V as centre and the dimensions *u* as radius. The eighteen intermediate dedendum curves 4 of said component gear wheel are described with the respective points W as centre and the link L *k* as radius." The specification goes on to give a brief outline of the process of machining the gears.—*June 6th*, 1929.

299,717. October 29th, 1928.—ELECTRIC CONDUCTORS FOR HIGH VOLTAGES, *International General Electric Company, of 120, Broadway, New York, U.S.A.*

For the economical transmission of power at very high voltages conductors with artificially increased diameter are employed. According to this invention, the conductors A are

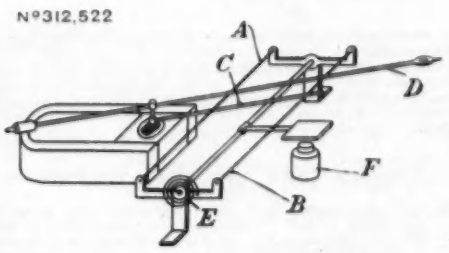


arranged in a circle and are held together by a ribbon B. The advantages claimed for the construction are that it permits the manufacturer to use a few wires of simple cross section. The manufacture of the cable is also simplified. The two lower illustrations show the cable with two different forms of conductor.—*June 6th*, 1929.

MEASURING AND TESTING INSTRUMENTS.

312,522. June 26th, 1928.—INDEX LOCKING DEVICES FOR ELECTRICAL MEASURING INSTRUMENTS, Evershed and Vignoles, Ltd., and C. Midworth, Acton-lane Works, Chiswick, W. 4.

It is here proposed to connect several electrical measuring instruments with several sources of electricity supply through one pair of wires. At either end of the pair of line wires there is a synchronous contactor, which successively puts the instruments in communication with their respective sources. During such time as the instrument is not in communication with its



source, its pointer is held in the position of the last indication. This locking is effected by a pair of smooth wires A and B mounted on a rocking frame. Between these wires there protrudes an arm C, which is a counterpart of the pointer D. The frame and the wires A and B are so impelled by the spring E that they tend to grip the arm C and consequently lock the pointer. At the moment of indication, however, the electro-magnet F is used to rock the frame to release the arm C. As an alternative to the electro-magnet, a hot-wire may be employed.—*May 30th*, 1929.

312,509. June 12th, 1928.—PRESSURE GAUGES, Colonel H. K. Heslet and G. E. Condliffe, The Research Department, Woolwich, S.E. 18.

The inventors propose to measure high and rapidly fluctuat-

ing pressures, such as those which occur in guns and internal combustion engines, by means of the varying electrical resistance of a piezo-electric crystal subject to the pressure. The crystal is shown at A and forms part of an electric circuit, the current in

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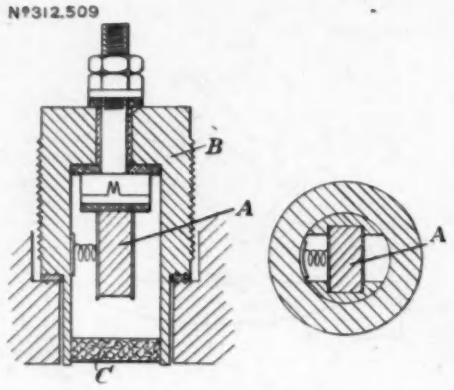

which may be measured in any convenient manner. The crystal is held in a strong casing B, the interior of which is filled with vaseline, and is closed at the bottom by a flexible diaphragm C.—*May 30th*, 1929.

312,658. February 24th, 1928.—MAGNETIC CORES FOR ELECTRO-MAGNETIC DEVICES, John Harold Buchanan, of Carnethy, Moss-lane, Timperley; and Metropolitan-Vickers Electrical Company, Ltd., of 4, Central-buildings, Westminster.

This specification describes a method of constructing a current transformer which has a substantially constant and preferably low reluctance over a considerable range of magnetising force, the object being to avoid variable-phase errors and consequently

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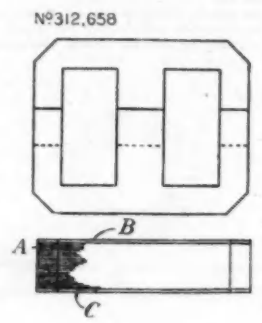


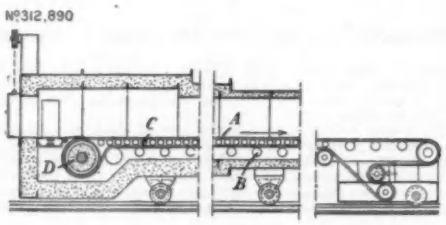
errors on the instrument to which the current transformer is connected. The transformer core comprises a central packet A of E-shaped laminæ stamped from silicon iron, and two similar packets B and C of similar laminæ stamped from a material having a very high permeability at very low values of magnetising force, such, for example, as Mu-metal, assembled on each side of the packet A, the laminæ being assembled in the well-known manner so that the joints are staggered.—*May 24th*, 1929.

FURNACES.

312,890. November 2nd, 1928.—LEHRS AND ANNEALING FURNACES, The United Glass Bottle Manufacturers, Ltd., T. C. Moorshead, and F. A. Hurlbut, 40, Norfolk-street, Strand, London, W.C. 2.

There appears to be an effort towards a regenerative effect in this lehr. The articles to be annealed are placed on a conveyor belt A, which may be of woven wire. This belt runs over end rolls,

Nº312,890



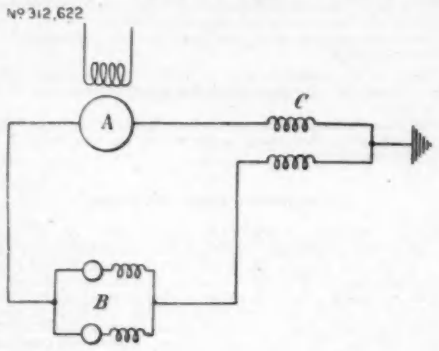
as shown, and its lower return side is supported by idlers B. Between the two passes of the conveyor there are other rolls C, which serve to support the upper pass and incidentally transmit heat from it to the return pass, so that the belt re-arrives at the heating roll D comparatively warm. Several alternative arrangements are suggested for heating the roll D.—*June 6th*, 1929.

MOTOR CARS AND ROAD TRAFFIC.

312,622. February 29th, 1928.—DEVICES FOR ELECTRIC GENERATING AND TRANSMITTING SYSTEMS, The English Electric Company, Ltd., of Queen's House, 28, Kingsway, London, W.C. 2; and Frederic Arthur Harper, of Dick Kerr Works, Preston.

This invention is particularly applicable to self-contained electric power transmission systems for traction purposes comprising a generator driven by a prime mover and motors carried by a vehicle. In such systems with a de-compounded generator, ordinary overload protection is ineffective, but protection against earths is desirable. According to one scheme described in this specification, a generator A supplies a power unit consisting of a motor or group of motors B. A protective device C in the form of a balanced relay is connected at some part of the circuit, preferably adjacent the negative terminal of the generator. The protective relay C has two equal and opposed windings in series, carrying the main current or a current proportional thereto, the point between the two windings being earthed as shown. Both windings may act on one core or on opposite ends of a rocking beam in known manner. Normally both windings cancel, but in the event of an earth at any other part of the circuit one winding becomes shunted and the balance

Nº312,622



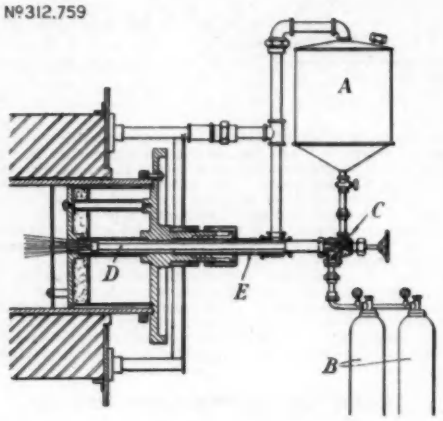
is upset, when operation of the relay may give a signal or operate a circuit breaker.—*May 29th*, 1929.

METALLURGY.

312,759. April 16th, 1928.—CASE-HARDENING IRON, C. Hummel, 74a, Heusteigstrasse, Stuttgart, Württemburg, Germany.

The inventor proposes to case-harden iron articles by subjecting them in a retort to the action of a carburetted gas produced by the atomisation of tar oil and its admixture with ammonia, nitrogen or some other gas, which may accelerate cementation.

Nº312,759



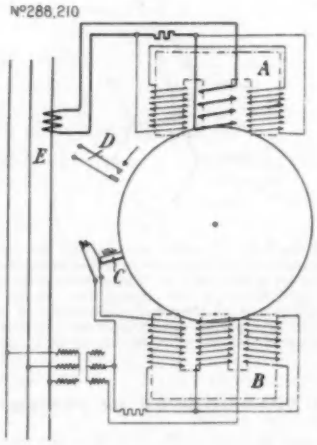
The tar oil is supplied from a reservoir A and the ammonia from the bottles B. The pressure of the ammonia is utilised at C to inject the oil into the mixing tube D. This tube is surrounded by another tube E, which is in communication with the top of the oil container A. The oil is consequently subject to the pressure within the retort.—*June 6th*, 1929.

MISCELLANEOUS.

288,210. April 3rd, 1928.—ELECTRIC RELAYS, International General Electric Company, Incorporated, of 120, Broadway, New York.

The control relay described in this specification comprises a movable Ferraris disc which is under the influence of a torque produced by the current and an opposing force produced by the voltage, the current and voltage coils being shown at A and B respectively. When the system is set in motion by the preponderance of the current torque, the torque produced by the

Nº288,210

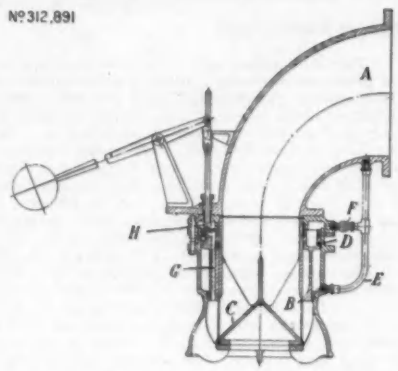


voltage is changed by the motion of the system into a damping force. When the extension C closes the contacts D a switch in the line E is opened. The invention presents the advantage that the current coils and voltage coils can operate on a common disc, or if several discs are considered to be more advantageous, they can be rigidly coupled to one another. There is also the advantage that no permanent steel magnet which might alter its magnetic condition and thus disturb the calibration is required.—*June 6th*, 1929.

312,891. November 6th, 1928.—FLOAT-OPERATED VALVES, F. M. Watson and Guest and Chrimes, Ltd., Don-street, Rotherham.

This float valve is intended for large services and aims at a reduction of the bulkiness of the float and lever necessary for its operation. The inlet to the valve is shown at A, the valve itself at B, and its seating at C. The valve is provided with an annular piston D, of which the upper operative surface is greater than the lower. The two faces of the piston are provided with pressure water by the branches E and F, of which F is regulable.

Nº312,891



Between the two faces there is a "leak-away" passage G, which is controlled by the ball cock H. The operation of the mechanism is obvious.—*June 6th*, 1929.

Forthcoming Engagements.

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of its insertion the necessary information should reach this office on, or before, the morning of the Wednesday of the week preceding the meetings. In all cases the TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

TO-DAY.

ELECTRICAL ASSOCIATION FOR WOMEN.—Fourth Annual Conference at the North-East Coast Exhibition, Newcastle-on-Tyne.

INSTITUTION OF MINING ENGINEERS.—Eighty-ninth general meeting at Nottingham.

TO-DAY AND SATURDAY, JULY 13TH.

ROYAL AGRICULTURAL SOCIETY OF ENGLAND.—Royal Show at Harrogate.

TUESDAY TO SATURDAY, JULY 16TH TO 27TH.

AIRCRAFT EXHIBITION.—Olympia. Seventh International Aircraft Exhibition.

WEDNESDAY, JULY 17TH.

INSTITUTION OF CIVIL ENGINEERS: YORKSHIRE ASSOCIATION.—Visit to Halifax Corporation Waterworks—Gorple Reservoirs. 3 p.m.

TUESDAY TO THURSDAY, JULY 23RD TO 25TH.

NEWCOMEN SOCIETY.—Summer meeting at Dartmouth, Devon. For programme see page 25.

SATURDAY TO TUESDAY, AUGUST 3RD TO 13TH.

INSTITUTION OF ELECTRICAL ENGINEERS: LONDON STUDENTS' SECTION.—Summer Tour, 1929. The tour will be held this year in Paris and Northern France.

TUESDAY TO FRIDAY, SEPTEMBER 10TH TO 13TH.

IRON AND STEEL INSTITUTE.—Autumn meeting at Newcastle-on-Tyne.

THURSDAY TO SATURDAY, SEPTEMBER 12TH TO 28TH.

SHIPPING, ENGINEERING AND MACHINERY EXHIBITION, Olympia.

SATURDAY TO SATURDAY, SEPTEMBER 14TH TO 28TH.

INSTITUTION OF NAVAL ARCHITECTS.—Summer meeting in Italy. For programme see page 380, April 5th, 1929.

PERSONAL AND BUSINESS ANNOUNCEMENTS.

A. LEE AND SONS, Ltd., of Bessemer-road, Sheffield, have entered into an agreement with the Anglo Galvanizing Company, Ltd., for galvanising strip with the latter's Bianco process of electro galvanising.

THE CONSOLIDATED PNEUMATIC TOOL COMPANY, Ltd., asks us to announce that the telephone number of its works at 104A, Lillie-road, Fulham, S.W. 6, has been changed from Fulham 5121 to Fulham 6645.

BROUGHTON COPPER WORKS (1928), Ltd., of Manchester, asks us to announce that as from July 3rd the title of the company has been changed to "The Broughton Copper Company, Ltd.," the name by which the company has been universally known for so many years.

THE BRITISH STEEL PILING COMPANY, Ltd., asks us to announce that it has completed arrangements with the Cargo Fleet Iron Company, Ltd., of Middlesbrough, to roll "Larssen" steel sheet piling, for which the former has acquired the sole selling rights for the British Empire.

THE ATLAS DIESEL COMPANY, Ltd., asks us to announce that the address of its office has been changed from 35, Surrey-street, Strand, W.C. 2, to New Oxford House, Hart-street, London, W.C. 1. Telephone: Holborn 7761/2; telegraphic address: Dieselmot, Westcent, London. All goods and parcels should be addressed to 17A, Albion-street, Caledonian-road, King's Cross, London, N. 1.

THE INSTITUTION OF ELECTRICAL ENGINEERS.—The annual conversazione of the Institution of Electrical Engineers was held at the Natural History Museum, South Kensington, on Thursday of last week, and, as usual, was a very enjoyable affair. The members were received in the Central Hall by the President, Lieut.-Colonel K. Edgcumbe, Mrs. Edgcumbe, and the Council of the Institution. As is customary on these occasions various sections of the Museum were open for inspection. The musical arrangements included selections by the string band of the Royal Engineers, and a concert in which some very able artists took part. All the arrangements were admirably carried out, and everyone present seemed to be having a very happy time.